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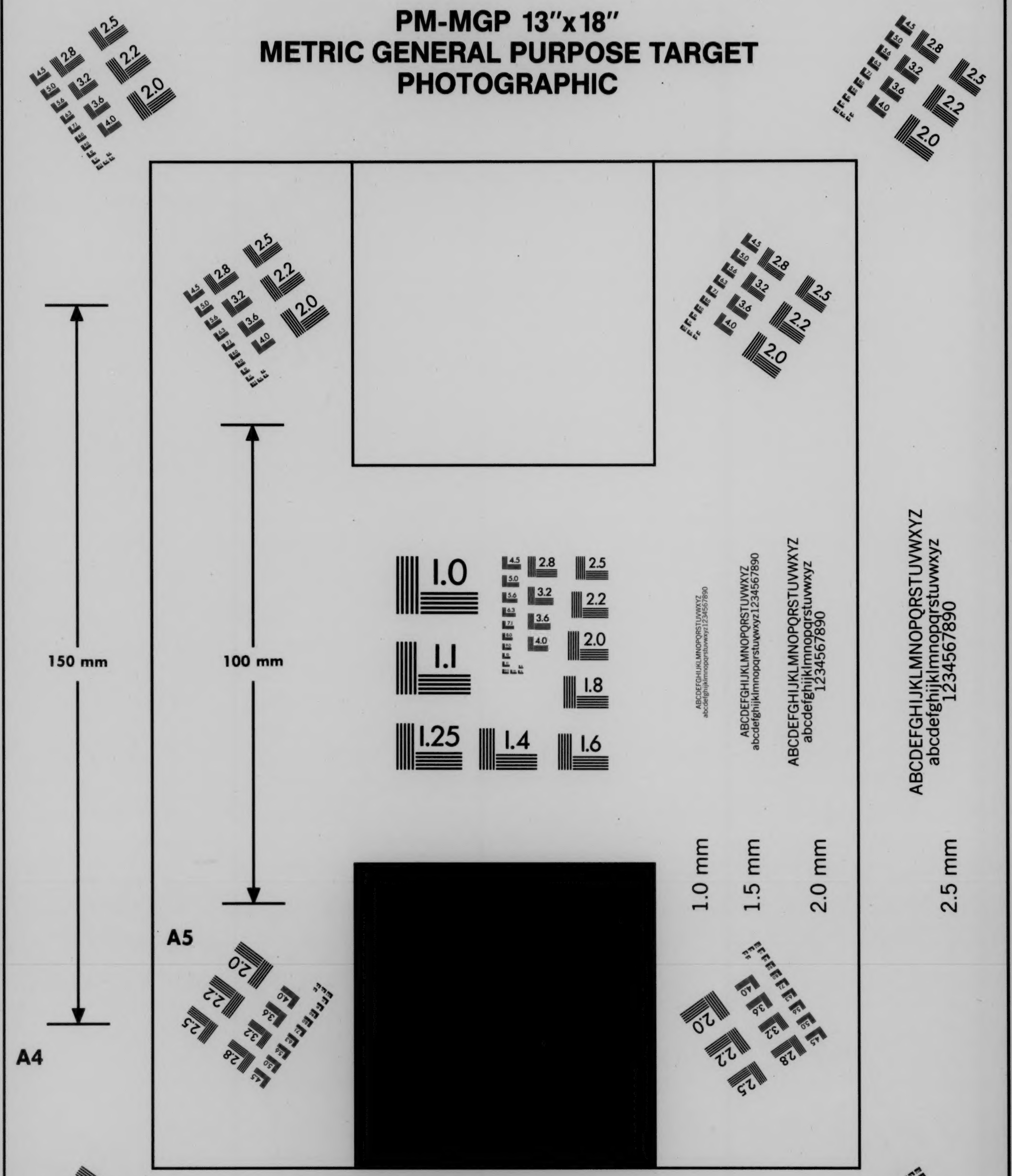

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CHEMICAL ENGINEERING SERIES

ACCOUNTING AND COST FINDING FOR THE CHEMICAL INDUSTRIES

BY

GEORGE A. PROCHAZKA, Jr., E. M.
Member American Institute of Chemical Engineers

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Dedicated
to my wife in recognition of her
patient cooperation and assistance

PREFACE

The object of this book is to show the manufacturer, the engineer, the accountant, and the student how to devise, install, and operate economical cost finding methods, and to present to them the relationships between this art and general accounting practice. To attain these ends the text has been divided into five parts. Attention is first given to the fundamental conditions on which correct cost calculations are based. After the second and the third parts, devoted to the non-material and the material cost components, the thought is directed to the proper handling of the results of these calculations and to the entry of these facts in the commercial records. The subject is brought to a conclusion with a discussion of plant and other fixed property accounting technique.

As the hardest part of accounting is not to grasp the principles, but to understand their application, the theme has been developed around a problem which actually shows how to calculate costs. The figures have been carefully selected from practice. To give the book as wide a scope as possible numbers have been substituted for the names of processes and materials, and only such terms as are well known in business have been used.

Some fourteen years of research work and considerable experience in instructing a staff underlies the data presented in the text. Much costly and tedious experimentation has finally led me to the gratifying conclusion that it is possible to get a firm economic grip on a business with a small clerical force and relatively few printed forms.

I am indebted to many friends and to the publishers for constructive suggestions. The existing literature has been freely consulted and in return I contribute to it the few seeds of accounting knowledge which I have won.

GEORGE A. PROCHAZKA, JR.

EAST ORANGE, N. J.
August, 1928

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PART I

COST-ACCOUNTING PREREQUISITES

ACCOUNTING AND COST FINDING FOR THE CHEMICAL INDUSTRIES

CHAPTER I

COST-ACCOUNTING FUNDAMENTALS

Prejudices Which Obstruct Cost Finding.

If we would develop a workable, effective, and economical method for finding costs, we must cast aside a number of deep-seated prejudices which, like all prejudices, exist because we have not critically examined the situation and ascertained the real facts. Cost accounting has been retarded in its advance to maturity largely because accountants have been handicapped through an over-zealous regard for the merit of knowing momentary article costs, through a misconception of the subject of errors, and through a lack of appreciation for the important role which logic plays in the science of accounting. Before we can attack to advantage the problem of cost accounting, we must possess a modicum of information on these three topics: article costs, errors, and logic.

Article Costs.

By the term *actual article costs,* specific reference is had here to the results of those abortive attempts to reduce to unit-product costs, for a transitory period, the entire expenses of a business. Such a procedure is not the offspring of sound judgment; but owes its existence to a strong emotional appeal. It looks like a good solution to a complicated problem merely because its worthlessness is hidden by an apparently profound exposition of precise facts.

Actual article costs are viewed with considerable suspicion by the layman. When we examine the circumstances under which these exact values are created, we hardly feel inclined to blame him for his attitude. He knows costs fluctuate. He is aware of the ramifications of cost accounting and the scarcity of places for properly controlling the calculations. A new cost is presented to him and, as there is no convincing evidence disproving the possibility of serious errors being buried in the final result, he finds himself afraid to trust the answer.

If we confine ourselves to actual article costs, we attach ourselves to something that can criticise our efforts, but cannot offer constructive suggestions. An article cost tells us very little. Only when we know the exact nature of the constituents of a cost and are able to compare them at all points with standard performance do we possess a full cup of knowledge. Actual article costs evidently have been made to appear more important than they really are.

Many of the expenses of business are constant and much of its output is variable. The two things are woven together in an intricate fashion. Some seem to think that to understand the pattern they must chop it up and equate the expenses against the output; yet to merely compare the design with what it should have been is much less costly and ever so much more instructive. As we ponder on this subject, we realize that the true objective of cost accounting should not be to tell us of the costs that have happened, but to tell us all about the cost components of a business so that we may create the results we would like to have. This purpose is easily accomplished by making careful comparisons with standard performance.

Although the modern tendency in cost accounting towards the use of standard costs has added valuable budgetary features to the science, besides making it more accurate, simpler, and cheaper to run, the customary adjustment of conservative values to actual conditions is not altogether beneficial. This overlooks a far more profitable use of these differences, for there is no better index to be had to the efficiency of factory operations than is to be found in the amount costs vary from type.

To develop this thought, let us imagine that a business is divided into two parts and that the manufacturing division turns over to the sales end all goods at standard cost. Each branch is now in a position to report the efficiency of its operations in terms of dollars and cents. The commercial end has the customary net profit to judge its work and the manufacturing part has a net cost variation to show how well its operations have been conducted. Thus, cost variations, instead of being a source of annoyance, can be made to serve a useful purpose.

Those who object to limiting cost accounting entirely to the use of type values should consider how much they add to their labors by going on into the actual cost of the moment, and how little they add to their store of information. Not the temporarily high or low costs, but the long-time average costs tell the real story of what a business can do. All energy should be bent towards reducing this average and that can be done only if cost variations are segregated and studied as to cause. Teaching us how to eliminate them is one of the most useful things cost accounting can do. What a manager really wants to hear is a sound explanation of the losses which arise when expenditures are measured in terms of the costs that should have been attained. Actual article costs merely show that somebody is good at arithmetic, but cost variations give the key facts for unlocking the doors to profitable operations.

Errors.

Accountants cannot be censured for their attitude towards errors because their particular bias has been inculcated by mathematical duties which give a life experience different from that gained in an observational science. They have not recognized that the art of cost accounting is divisible into two parts, namely, field work and office work. In this, the practice of land surveying is closely paralleled for there, also, is to be found a sharp separation into two parts—field work and office work. In both cases absolute accuracy is required in the office for in no other way can the calculations made with observational data be kept under thorough control.

With reference to field work, surveying teaches us that it is impossible to measure exactly. The most probable value of an unknown is all we can hope to establish, and the accuracy with which it is established depends directly on the number of observations made and the method used. For instance, the distance between two points can be roughly determined by pacing, can be established satisfactorily for most purposes by transit and chain, and can be fixed with little error by a base-line survey. The particular method used and the number of observations made depends entirely upon what purpose the answer is to serve.

Further comparison shows that field work in cost accounting involves a problem of greater complexity as to errors, because the quantities subject to observational determination are variable in nature, whereas those of surveying are fixed. The failure to realize that the object is to fix the orbit of an enterprise and not to measure with infinite exactness each and every measurable quantity has been the secret cause of many a headache over this task. By referring to the general books we can define the major outlines of our own business universe. We can learn whether we travel like a comet and get close to the sun of profits only at long intervals or whether we follow a nice elliptical path near it at all times. Once this and other ordinary facts and forces are known, then we can safely apply measuring methods whose concomitant errors are in harmony with the results to be attained. Unless a person engaged in cost accounting has a thorough understanding of the subject of errors, his efforts are apt to trespass into the realm of childish fancies.

In review, then, office work must be performed with absolute accuracy, using, however, no more decimal points than common sense allows. Basic factory statistics can never be determined exactly and should never be established with greater accuracy than the worth of the problem.

Logic—Principles of Classification.

Although the edifice of accounting is built on a foundation of arithmetic and logic, none of the numerous text books seem cognizant of the average reader's lack of schooling in the principles of logic. Fortunately, but little of this abstruse science has any bearing on our subject, yet that small portion is of great importance in cost accounting.

Classification and the converse operation, division, are governed by three rules. First, only one principle can be used for division. Second, there must be no overlapping among the various divisions. Third, the divisions must be exhaustive. Only after a fourth rule has been added can this wisdom of the logicians be applied effectively to accounting. Each division must carry a sufficient volume of transactions to conform to the dictates of economy in accounting, and no division should be so large as to retard accounting analysis.

Let us determine what we must do to conform to the laws of classification. The selection of a principle of division depends on the point of view; yet to depict the events of accounting completely often requires records made from more than one point of view; consequently, the first rule may imply the use of several complete schemes of classification. The second rule directed against overlapping is not complied with readily unless there is at hand a manual of instructions defining the various classifications, for some transactions occur so rarely, have so few distinguishing characteristics, or have been grouped so arbitrarily that their proper entry without consulting such a compilation is simply a matter of chance. Classifications are easily made exhaustive by injecting a miscellaneous division. Economy in accounting is obtained by combining minor groups and by splitting major groups.

Article-cost Classifications.

Correct schemes of classification are a prerequisite to successful accounting. The usual method of subdividing article costs can be revised to advantage. Possibly some early accountant read of Caesar's division of all Gaul into three parts and adopted a similar scheme. Others must have thought it good for we invariably see article costs split up into material, labor, and expense. This procedure is not correct and, therefore, starts us off on the wrong track.

An article cost can be divided, using origin as a principle, into two parts whose differentiae lie in that one comes from intangible departmental activities called *processes* and the other from tangible materials. When we view article costs from this angle, we see the basic principles of manufacturing more clearly, we can reduce different industries to a common denominator, and we can develop a simple standard system for finding costs which can be used effectively in any factory. This division of article costs into process costs and material costs is essential to correct cost accounting.

Process-cost Classifications.

To understand process costs we first must examine the total cost of all the activities in which a manufacturing enterprise is engaged. This amount has been represented as a triangle in Fig. 1, because it must be viewed from three separate angles if it is to be subjected to a thorough analysis. Unless these three positions are taken in scrutinizing the total expenditures (exclusive of raw materials), the complete story is not considered, and, as is always the case in accounting when intermediary steps are omitted, the facts depicted become obscure.

The first viewpoint, cost elements, investigates the kind of things bought to run the business. These vary in different industries, but for illustrative purposes they have been taken as depreciation, insurance, taxes, expenses, supplies,

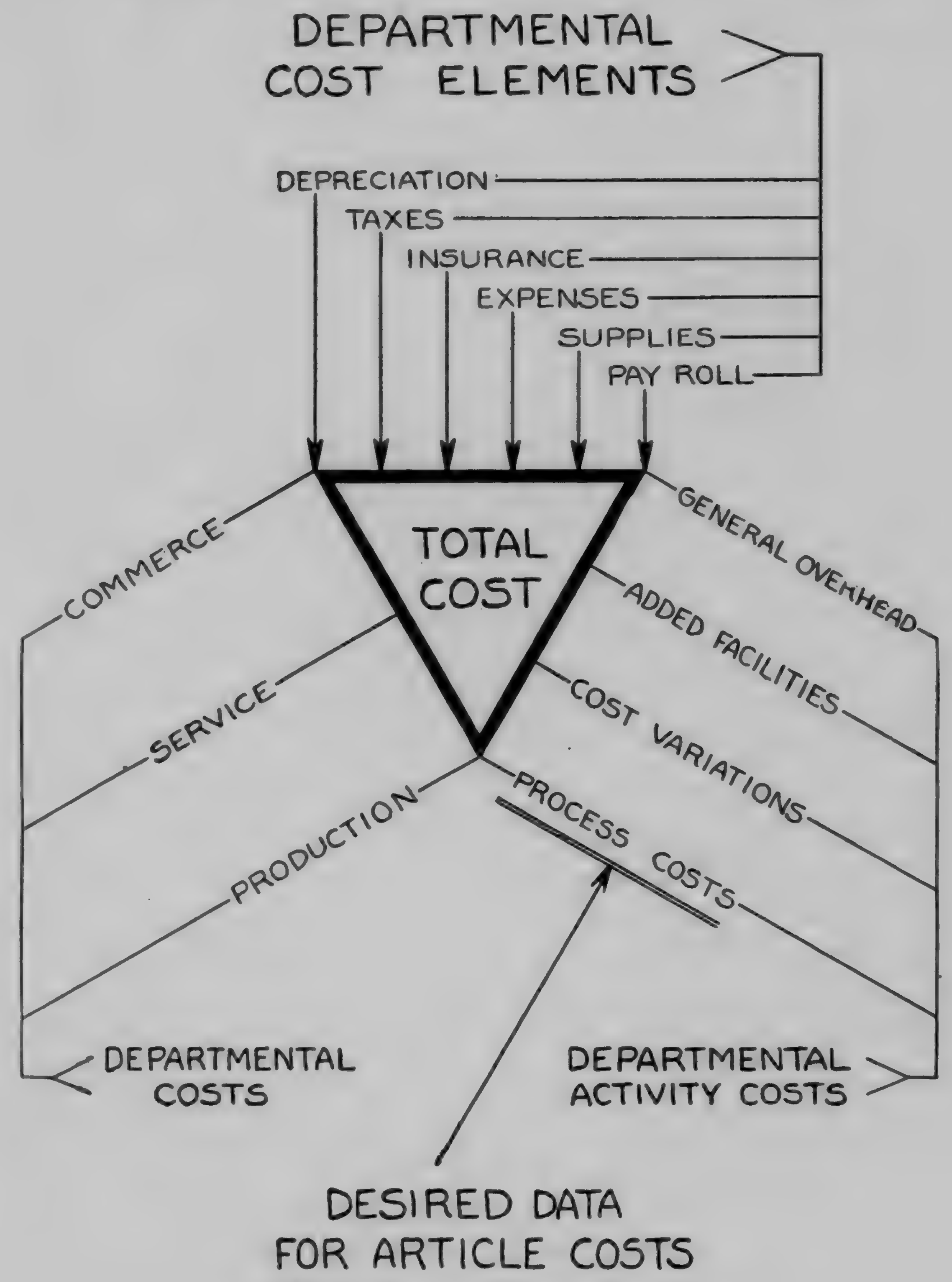

Fig. 1.—Analysis of process costs.

and payroll. In the second position, we study the cost of running the various departments into which the business has been divided. Having equated cost elements against departmental costs, we are ready to occupy the third position and translate departmental costs into results. The four resultants of departmental costs are: process costs, cost variations, added facilities, and general overhead.

More information on these components will be given in subsequent chapters, for at this point it is desired only to show that the non-material part of article costs cannot be calculated as just so much labor and expense, if it is the intention to present a true picture of factory costs. Only one branch of activity costs, *i.e.*, process costs, has anything to do with article costs; yet this component cannot be deduced rightfully without sorting out the entire expenditures, first as to cost elements, second as to departmental costs, and third as to activity costs.

Material-cost Classifications.

The materials a manufacturer handles are divisible into three major groups: raw material, work in process, and finished stock. Each of these can be divided further along lines too well known to need discussion. The classification seems simple and not possessed of any complexities, but that is not the case, for every once in a while a material crops up as a willing candidate for a place in any one of the three divisions. There are some goods which, at various times, are either bought or manufactured and, besides being used in the productive processes, are also sold to customers in the same way as other finished goods. By listing such articles in each class and transferring, from the inventory carried in the most important group, enough stock to satisfy the different transactions, an easy solution to the problem is had.

The term *raw material* should be interpreted in as broad a sense as possible. Any article whose consumption runs into sizable figures and varies in direct proportion to the manufacture of a particular product should be classified as a raw material rather than as a supply, even though the material is not present in the finished goods. As materials are checked more closely than supplies, such treatment is conducive to greater accuracy in accounting.

Work in process subdivisions are generally, but not necessarily, identical in name with the finished-stock headings. Their differentiae lie in the uncompleted state of the work. Some industries require a major classification intermediary to work in process and finished stock. This intermediate, component part or component material division, as it is called, relieves the other accounts of a vast number of parts, complete in themselves, but unsaleable until they have been assembled into finished marketable goods.

The Requirements of Cost Accounting.

If the calculated costs do not tell a story which anyone familiar with manufacturing can understand, then the accounting methods have not been correctly developed. An accountant has a message to deliver and it should be so delivered that he need not stand by in the capacity of interpreter to explain his work. In other words, his technique is of paramount importance.

The most essential requirement in cost accounting is to have the facts so clearly recorded that all changes in results can be quickly traced back to their origin where the underlying causes are fully revealed. When we try to show what actually goes on in a business we arrive at a complex set of records; yet in spite of this the scheme must be neither difficult nor expensive to run. By setting cost patterns for the operations to follow instead of casting into costs the uncertainties of production we not only attain these ends, but also secure that immediate review of results and trends which is so essential if a business is to be kept operating in profitable channels.

Outline of Cost Accounting.

Having examined a few important basic principles we are in a position to consider the technique of cost finding. The foundations of cost accounting are an effective departmental organization, a well-developed general ledger, and a comprehensive system of factory records. The first thing to do is to study the functions having an active part in the enterprise. The scheme we adopt for classifying them will be governed largely by the volume in which each kind occurs. After we have fixed in mind the departmental organization, we can turn to the general ledger and see that the expenditures flow into it in channels which expose a true cross-section of the business. Each one of these accounting tributaries must carry a sufficient volume of transactions to justify a separate contribution to the main body of industrial costs. After this, factory records can be designed to report the facts underlying the charges for materials and services delivered to the various departments. The thought is the same as that which leads us to use shipping memoranda to get the data for billing customers.

Although the departments, the ledger accounts, and the underlying reports will differ, the central records through which the cost calculations must pass will be practically the same in every business. The forms used to illustrate these key situations show a convenient, but not the only way of linking the costs into a compact accounting unit. There are seven of these pivotal points:

1. The tabulation of cost elements.
2. The distribution of costs to departments.
3. The process-cost ledger.
4. The raw-material ledger.
5. The work-in-process ledger.
6. The finished-stock ledger.
7. The cost journal.

As the cost of running a business does not appear on any record we must set up the elements so that we know the facts with which we must work. They are deduced in

terms of general ledger accounts because, finally, the accounts must be entered in the general ledger.

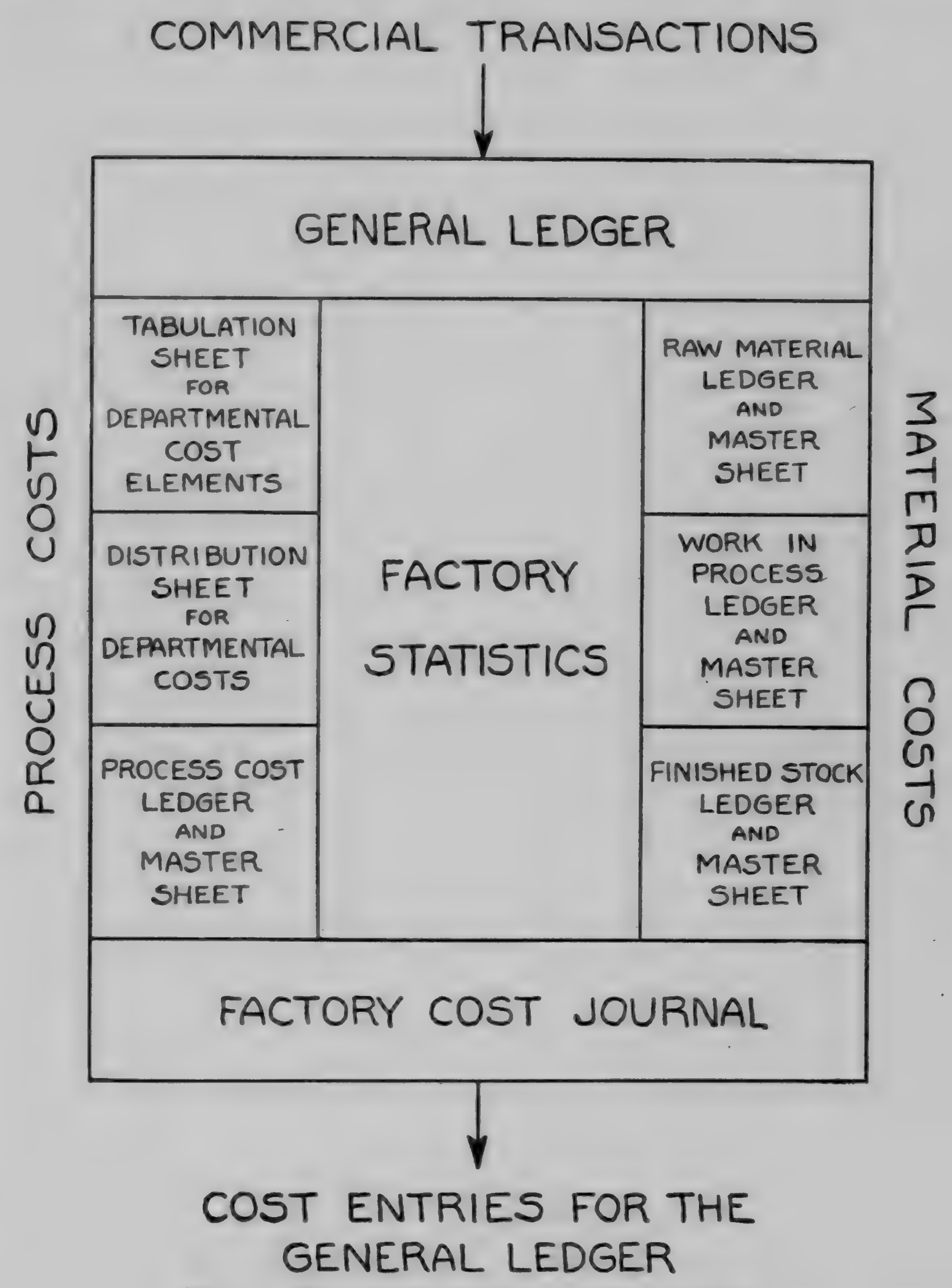
COMMERCIAL TRANSACTIONS
GENERAL LEDGER
PROCESS COSTS
TABULATION SHEET FOR DEPARTMENTAL COST ELEMENTS
DISTRIBUTION SHEET FOR DEPARTMENTAL COSTS
PROCESS COST LEDGER AND MASTER SHEET
FACTORY STATISTICS
RAW MATERIAL LEDGER AND MASTER SHEET
WORK IN PROCESS LEDGER AND MASTER SHEET
FINISHED STOCK LEDGER AND MASTER SHEET
MATERIAL COSTS
FACTORY COST JOURNAL
COST ENTRIES FOR THE GENERAL LEDGER

Fig. 2.—The essential books for cost accounting.

The distribution of the cost elements to departments is a long, involved, but not intricate problem. To be able to check the work quickly and follow back into the fundamental statistics with ease, it is advisable to perform the operation on one piece of paper.

The process-cost ledger furnishes a useful medium for carrying on the departmental costs to the point where we arrive at the cost of the general overhead, the added facilities, the wasted effort, and the process changes.

The three material ledgers bring to a focus data from invoices, bills of sale, material-consumption memoranda, etc., and give us the cost facts on each item of raw material, work in process, and finished stock. The cost journal serves to summarize all the cost records for entry in the general ledger.

If these seven books or records are designed correctly and operated properly we have a complete cost circuit from which nothing can escape. Table I gives an outline of the technique and Fig. 2 shows the essential books and records. Many constructive suggestions as to forms and methods of handling details will be found in "American Mine Accounting" by W. H. Charlton, published by the McGraw-Hill Book Company, Inc., and in "Factory Costs" by Frank E. Webner, published by The Ronald Press Company.

Table I.—The Fundamental Technique of Cost Accounting

A. Prerequisites:
    1. Suitable General-ledger Accounts
    2. A Departmental Organization
    3. Suitable Factory Records on All Activities

B. Process Costs:
    1. Establish Departmental Cost Elements
    2. Distribute Costs to Departments
    3. Measure Performance in Terms of Standard Costs

C. Material Costs:
    1. Get Raw-material Costs
    2. Get Work-in-process Costs
    3. Get Finished-stock Costs

D. Results:
    1. Journalize Cost Records
    2. Enter Costs on the General Ledger

Epitome.

The principles of cost accounting demonstrated in this book have four salient features. The general books of account have been extended so as to include cost work on an equal basis with the ordinary commercial facts. Every effort has been made to make it possible for the manufacturer to develop his notions on article costs into refined reliable cost standards. The records have been so devised that it is a simple matter to trace all the calculations and to tell the exact constituents of each cost. Using the economic structure of the factory for the framework of the system makes it easier for the manager to get the costs he would like to have.

CHAPTER II

DEPARTMENTAL ORGANIZATION

Why We Must Have Departments.

The formation of departments must precede cost calculations because intelligent accounting requires a groundwork of well-laid facts. To make goods we must stimulate an organization to activity, and to do this we must spend money. The cause of our expenditures is the desire to manufacture goods and the effect is the running of departments. Some may believe the recording of the intervening stage unnecessary, yet such hurdling of intermediary steps is always fatal to informative accounting. Unless the full story is told, the facts will remain obscure.

Principles of Departmentization.

To go into all the details of organization principles is not within the province of this work, and, besides, extensive literature on this subject already exists. Everybody who is interested in the subject should read "Modern Organization" by Charles DeLano Hine, published by the Engineering Magazine Company, New York, 1916. Coming from the pen of a man who not only knows theory but also has lived through organization difficulties, this book, replete with a sound philosophy of management, is well worth reading.

Departments make a business easier to handle. Divisions are organized by segregating into effective groups employees with common duties. The actual lines of demarcation, however, are dictated not by the function but by the volume of activity, for here, as in all other business classifications, the special fourth rule must be observed. In illustration of this, we find large plants with an accounting department, a billing department, a purchasing department, and a stenographic department; whereas, a small factory has just a business office consisting of two or three people with these multifarious duties.

A high degree of efficiency has been obtained in modern organization by specialization and centralization. Many people do not seem to realize that these efforts can be carried too far. After the economical point has been passed, centralization feeds on other departments, impairing their ability to operate as self-contained units and ultimately lowers their efficiency. Major Hine points out that if banks had fallen into the fallacies of the industrial world, they would have had the janitors of all branches report to an "alleged expert chief" janitor in some distant city.

The application of the principles of departmental organization requires extensive practical experience for with much of it we find ourselves on the horns of a dilemma. While trying to avoid a diffuse scheme, we fall into the error of making combinations which are not susceptible to any rational method of cost allocation. The personal element also often gets us into trouble. Smith is a good man, a horse for work, so we add to his duties this, that, and the other thing until, before we know it, the department under him is nondescript to the point where its activities must be entered on the cost records like a fork full of manure thrown over a grass plot. A department conceived so as to conform to the dictates of function, volume, efficiency, utility, and accounting bespeaks a distinct mental effort.

The Three Kinds of Departments.

From the standpoint of output (*i.e.*, the work they do), the departments of a manufacturing enterprise may be exhaustively divided into three groups. We have, therefore, commercial departments, service departments, and production departments. As the distinctions between these three are most important in cost work, each group will be discussed at length in an illustrative but not exhaustive manner. (The latter course would get into encyclopedic dimensions.)

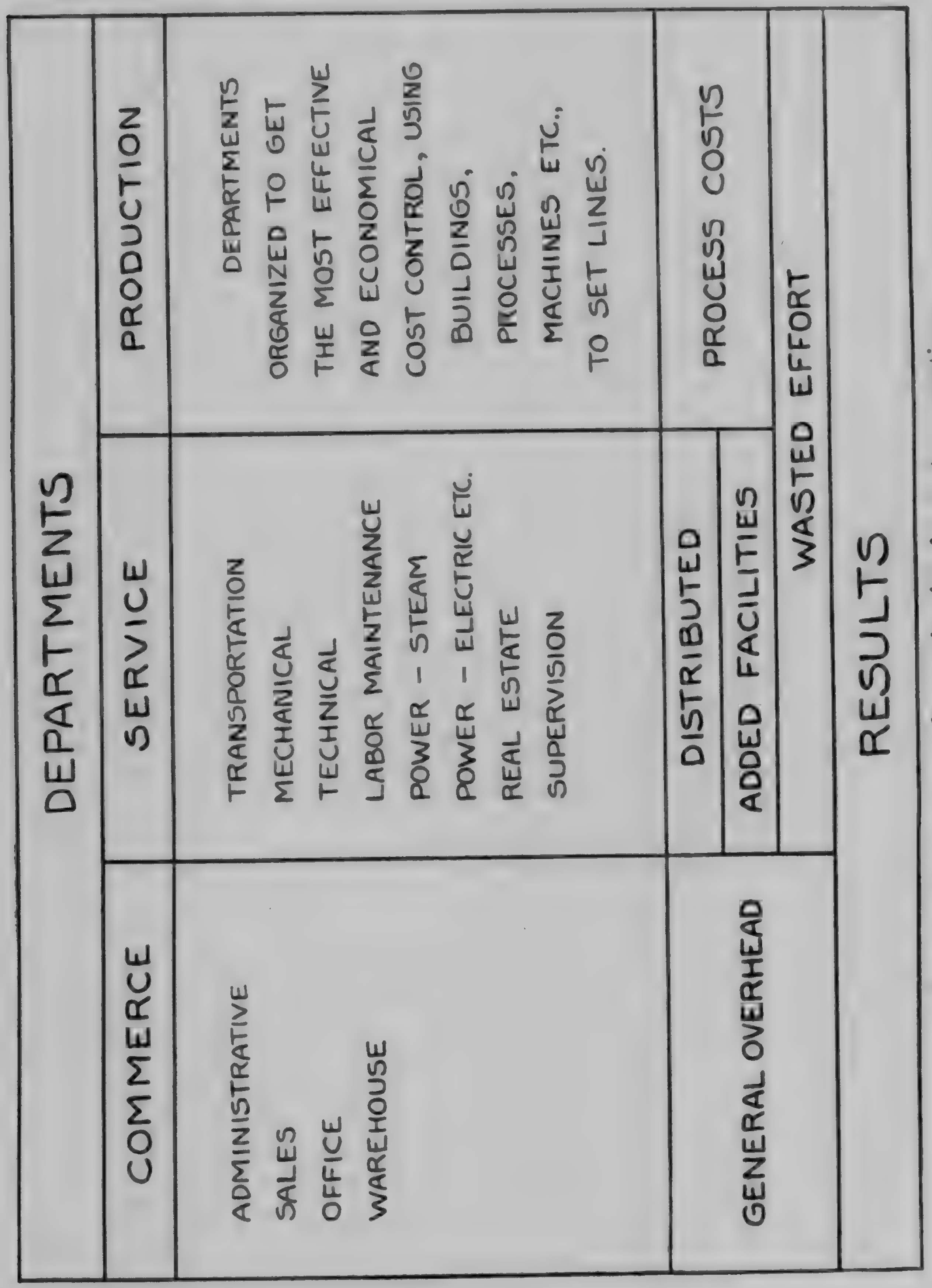

Fig. 3.—Departmental organization for cost accounting.

Commercial Departments.

The commercial departments attend to the welfare of the business as a whole and thus are concerned only indirectly

with specific articles. The administrative department, the sales department, the office, and the warehouse department are four well-known subdivisions of this category. Their costs are not chargeable to specific manufactures but constitute a general business overhead deductible from the gross profit obtained through the sale of goods. In this respect, the commercial departments differ from the other two types.

Administrative Department.

The verb *to administer* meaning to have charge of affairs, is not a precise word and hence the adjective describing this department is not suited to its task, for the duties of this division are not clear cut. Anything pertaining to the general running of the business may be so classified, but care should be taken that nothing more properly related to factory operations is so included.

Sales Department.

The well-known duties of the sales department require no explanation. Whether the department embraces one man or has national scope is immaterial, because a single account is sufficient to collect all sales items having any connection with factory accounting.

Office.

Under the heading of office usually are included such activities as accounting, cost finding, purchasing, billing, typing, etc. The needs of factory accounting are satisfied by treating these functions as a unit. Those interested in further details will find much material of value in Dr. Lee Galloway's "Office Management," published by The Ronald Press Company, New York, 1919.

Some items of office work are not of a general overhead character but are so included owing to the extreme difficulty of separating them from other costs with which they are merged. When a company does its own construction work, a heavy burden is thrown on the office force without due recognition of its different accounting aspect. If the new addition has been built by an outside contractor, the clerical costs would have been included in the invoices received. In one case the office costs of construction are written off as an expense and in the other they are charged to the capital account. The seriousness of the situation depends on the magnitude of the construction work.

Warehouse Department.

The warehouse is a commercial department because it exists mainly to equalize the irregularities between supply and demand. Warehouse cost, like interest on investment,[1] is a thing which is best incorporated with the calculations made to ascertain proper profits. (Great risks and long turnovers require big profits.) As far as the major technique of factory accounting is concerned, this department can be handled as a unit. Further analysis is not only desirable but also necessary; detailed methods, however, are too highly individual to admit of treatment in this book.

The warehouse department usually takes care of shipping and receiving, as both raw materials and finished goods are stored there. Supplies may be conveniently placed under the same roof, but they are not often handled advantageously by the same organization. The reason for this is to be found in that materials, being the life blood of a business, should not have their channels of flow subject to the hazard of incidental and unnecessary obstructions. Materials represent big investments in few items and supplies small sums in many items. Supplies, to be economically disbursed, must be controlled by factors in immediate contact with the points of consumption. Much material of value on the warehouse division will be found in the two books by Twyford, "Purchasing," and "Storing," published by D. Van Nostrand & Co., New York.

Service Departments.

The service departments differ from all other divisions in that their output is primarily directed to facilitate the operation of the other two groups. Being unable to obtain the performance of certain activities in a satisfactory manner through outside sources, it often becomes necessary to create separate business ventures within the main enterprise to supply these needs. Although we do not often consciously look at the matter in this light we must do so if we are ever to unscramble a large proportion of factory costs which, on any other basis, simply remain a black void of expense to be allocated in proportion to some known but unrelated quantity.

The idea of service departments is brought to maturity when it is extended to include as divisions all factory activities essential to the conduct of processes but not actually part of them. To more fully explain the subject, several prevalent types have been selected for discussion; their basic functions are: transportation, mechanical service, technical service, labor maintenance, power, real-estate maintenance, and factory supervision.

Transportation Department.

The transportation department may be so large as to need subdivision into an internal and an external branch, or it may occur in its most rudimentary form as a mere appendage of the warehouse department. The business of this section is to move goods and by setting it up as an entity we put ourselves in a position to study the cost of moving goods.

Mechanical Department.

The mechanical department may be concerned only with maintenance work or it may run the entire gamut of constructive activity. In the latter event, separate units, such as machinists, carpenters, pipe fitters, riggers, masons, etc., must be recognized.

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[1] Atkins, P. M., "Industrial Cost Accounting for Executives," McGraw-Hill Book Company, Inc., New York, Chap. XVII, Interest as an Element of Cost.

Technical Department.

The word *technical* has here been used in a generic sense, having reference to a type rather than to a specific department. Chemical, physical, or research laboratories and engineering or inspection offices are well-known branches of this division. The efforts of the technical department are directed to the control of products or to the creation of intangible assets, such as patents, formulae, design, etc.

Labor-maintenance Department.

The maintenance of a large staff of employees creates enough work to keep one or more people busy. The cost of hiring men, taking their records, assigning lockers, handling payrolls, keeping time, etc., taken collectively, runs to a substantial sum. Even though the department tends to become nothing more than an accounting name, it will often pay to recognize it in order to get a convenient channel for collecting the numerous small expenditures made to keep a working force in the factory.

Power Department.

Power is used here to designate a group of heterogeneous things under the jurisdiction of one department. Steam, electricity, mechanical power, compressed air, vacuum, refrigeration, water, gas, etc., all bring refractory problems which cannot be solved without following them through all of their ramifications. Above all other expenses of a factory, these should be singled out for departmentization. Their consumption is unrelated to any other quantity and can only be ascertained by actual investigation. Where process steam is used, it is advisable to split this department into two parts, calling one steam and the other electric and sundry power.

Real-estate Department.

The real-estate department usually will be an account rather than an active department. The upkeep of grounds and buildings may be in the hands of the general manager, the superintendent, or the master mechanic. Actual work may be done by outside contractors, a special crew of men, or by the mechanical department. Watchmen's services, fire-equipment maintenance, snow removal, yard cleaning, depreciation, taxes, insurance on buildings, and those other manifold items constituting the aggregate of real-estate expenses are all distributable on an area or value basis to the various departments using these facilities. A real-estate service department is an accounting necessity, irrespective of how rudimentary or highly developed the actual function is.

Supervision Department.

Although the nucleus of the supervision department is the general superintendent and his staff, to it should be added that part of the office force working on production and article costs.

Production Departments.

The organization of production departments is a subject whereof it is difficult to speak without taking up specific instances. Cleavage lines must follow the machines and not the products. The reason for this becomes clear when we remember that we departmentize to get process costs, not product costs, even though the two terms at times may seem synonomous. The mental journey to the ultimate goal, product costs, cannot be made in one startling leap but must be made over the trail if our thoughts are to reach our destination with certainty. Having determined process costs, we can allocate them to products without difficulty.

The size of the undertaking, the type of process, and the layout of the plant are three factors having great influence on departmentization. The larger enterprises must resort to group control of machinery, whereas, the smaller manufacturer can focus on individual machines. At times a process cost can be obtained satisfactorily for a series of operations in different machines and again each step must be determined separately. The type of process used and kind of product made set the rules. In some cases an incorrect layout may dictate divisional lines which, although they are undesirable, give the only possible solution to the problem.

The initial efforts always should be aimed at getting as large a block of machines as possible into one department. From this point it is an easy step to further subdivision. There are times when economic conditions make it advisable to single out units for intensive cost study which, under normal operating circumstances, would lie buried in a department. For individual machinery we can conveniently use the expression of A. H. Church "production centers."

Combinations of these give the larger units production departments. The facts for judgment reside in the individual problem and only patient application can bring them out. Let it be remembered that the primary object is to get process costs, not product costs, and that the first conclusions rarely will be the ones most worth while.

The Results of Departmental Activities.

After examining organization principles and practices, it is fitting that we should turn to the results achieved by the activities which we have been trying to regulate into precise channels. Some may think the final profit gives all the information they ever need know. Carnegie answered that long ago when he said, "Let me see your costs." The profit may please us into neglect of the methods of attainment so that, flushed with success, we go on without adequate protection against the pitfalls which beset us. We must give deep consideration to the true worth of our accomplishments, regardless of this appraisement by the markets of the world.

The activities of a business, in terms of the ultimate effect, can be reduced to four distinct propositions. All the money we have spent to keep the business going finally appears as general overhead or burden of expense, as added facilities, as process costs for finished goods, and as wasted effort. These four things exhaust the total expenditures; there are no other possibilities. With each of these, if we are to know that our results are not ludicrous notwithstanding the handsome returns on a basis of market values, it must be determined whether the ends justify the means.

General Overhead.

The general overhead is the burden of expense created by the four commercial departments, administrative, sales, office, and warehouse. Lacking in comparable standards, the true worth of general overhead is most difficult to establish. Antecedents give some basis for making judgments but the real test must always be: What will happen if a particular item is cut off from the business?

Added Facilities.

The term *added facilities* is used here in a comprehensive sense to include not only genuine new assets but also charges which are fundamentally in the nature of a prepaid expense. Such a procedure is justified by the clarity it adds to the cost picture. These values created by the service departments are finally expressed as increments of raw materials, supplies, fixed property, or of the intangibles, such as patents, formulae, design, etc.

Raw-material costs are not complete for factory accounting use until all charges incident to placing them in stock have been added. The work performed by the transportation department in unloading, handling, and storing of raw materials is, according to this interpretation, to be considered as an increase to the assets of the company, although its liquidation value may be zero. In other words, stocking raw materials adds to the facilities or improves the potential position to manufacture.

It is not uncommon to find a concern manufacturing part of its supplies. A mine having a well-equipped machine shop makes spare parts for its rock drills, thus usefully employing the idle time of its mechanics. A large hardware concern finds a saving by setting up a separate printing department for labels, etc. A biscuit company increases profits by establishing a separate factory to make packages. By giving accounting recognition to supplies manufactured, even though they be quite incidental, we get a better realization of the true costs of production.

The tendency of factories to do all or part of their own construction work is well known. Added facilities of this description are in the form of renewals of existing structures and equipment, or in the form of new buildings and machinery.

In many industries considerable time and money must be spent in the development of new methods and in the improvement of old methods. Research directed to extend the uses of a product also falls into this category. Judging from advertising literature, it must have cost the International Nickel Company substantial sums to develop markets for monel metal. The good hard dollars dribbled away over these things in a period of years should be a matter of record. Having capitalized these activities as patents, formulae, design, good will, etc. does not mean they must be carried on the books as an asset for more than a transitory period. Both the management and the stockholders should know how much it costs to keep their enterprise abreast of the times.

The true worth of internal expenditures for handling raw materials, making supplies, and building fixed property in almost every instance, can be checked up by securing outside competitive figures. There is no criterion other, than judgment to appraise the worth of money diverted to the intangibles. A few minutes in the United States Patent Office should be enough to convince anyone that existing intangibles, if one were able to compute them, undoubtedly would show a worse ratio of returns to investment than gold which, on the average, is said to cost about $23 an ounce and yet is worth only a little over $20 an ounce. The bonanza aspects of successful ventures notwithstanding, caution and judgment should be allowed to have their say in measuring expenditures for patents, formulae, designs, etc.

Process Costs.

To get correct standard process costs should be the major objective of every cost system, for once this citadel of the unknown is captured, the other points offer little resistance to the onslaughts of investigation. That the idea should be to get accurate article costs for a transitory period is a chimera which has long blocked the best development of cost accounting. Accurate costs simply hash over results good, bad, and indifferent to reduce them to unit values; but correct process costs supply a most definite objective in that they map the entire terrain within which the factory must operate.

The word *correct* here has two possible interpretations. Process costs can be correct for our own organization methods and equipment, and they can be correct in terms of the present sum total of human knowledge. Although we are interested primarily in having the facts for our own organization we must ever be ready to check them against the external situation. Study, enlivened by imagination, will ultimately reveal the true worth of process costs.

Waste.

A revelation of the sum total of wasted effort is the greatest gift within the power of any cost system. Such a figure set up on the books prescribes a definite task for the management and it is indeed a delinquent management which does not vigorously seek to extinguish this value. To permit these facts to be merged into so-called actual article costs, wrong in principle, and dangerous in practice fosters the ancient habit of sweeping dirt under the rugs.

The waste of effort and materials in this discussion will be called cost variation. Even though the thought may at first seem anomalous, cost variations can vanish and reappear as a positive value in the form of an additional profit. Snap judgment on such a showing should not be allowed immediately to propose revised costs. It is easy enough to cut these things down but let us first see whether we can give continual expression to them. As profits in the bank owe their existence to correct mean averages, cost variations, either negative or positive, should not be interpreted into new standards of performance until time has revealed their true meaning.

Organizing Departments.

This discourse on organization cannot be brought to a satisfactory conclusion without again sounding a note of warning against some of its fallacies. The illuminating Major Hine has brought out many of them but he has not touched on the difficulties encountered by the smaller works. Departmental organization offers an impressive method of analysis for cost determination. Inspiring as the picture may be, however, we should not let it overawe us into foisting on a little plant a scheme out of harmony with best operating interests. The small enterprise must delve into organization principles and practice, but much of the uncovered material can be safely left as a paper proposition for cost purposes. Labor turnover, ever a sword of Damocles hanging over the continuity of operations, must be countered by asking others temporarily to assume extra duties. A small plant cannot afford to let the dignity of office in a department obscure the realization that, after all, the main object is to get the day's work done. Like all things, organization has its limitations; it is not a panacea for management, and it is a subject to be approached with caution and judgment in spite of its ability to assist in cost finding.

CHAPTER III

GENERAL-LEDGER ACCOUNTS

Why We Must Begin with General-ledger Accounts.

Although the general commercial books used by manufacturing companies have been developed to show every penny going into and out of a business, as yet they have not been expanded to the point where they have very much to say about internal affairs. Cost calculations are necessary to fill in this hiatus in an otherwise complete story. If we are to have an informative chronicle of business events, devoid of lacunae and kept in a single set of records, then the cost accounts must begin and end as general-ledger accounts.

Accounting—A Review.

The few and simple principles on which accounting is based are in sharp contrast to the years of study and practice required to attain ease in their application. Every action in business entails an equal reaction. This gives us the debits and credits of bookkeeping. A journal lists the transactions as they occur and notes the two components. A ledger classifies them into accounts. At the end of a period the books are closed and we have the complete story for that interval. Nothing could be simpler.

The improvements in accounting have been directed towards finding cheap ways of handling the voluminous entries involved in present-day business. The journal has been split up and modified until it bears no resemblance to the original book. We have now a general journal, a cash book, a sales book, a purchase invoice book, etc., each one of which classifies transactions into monthly accounts. The main or general ledger has persisted as a good old-fashioned bound book, as this form alone seems to offer reasonable safeguards against alterations. Most of its detail has wandered into the journals and into subsidiary ledgers, such as the customers' ledger, etc. The general principles of accounting are well brought out by P. J. Esquerré in his "Applied Theory of Accounts," published by The Ronald Press Company.

Classification of Accounts.

Accounts show either cause or effect. Names such as *nominal* and *real* have been proposed for the two types, but none of the terms is really descriptive. The accounts depicting effects deal with property, rights, and obligations, *i.e.*, they express real values. The other class shows how much influence specific elements have had in causing changes in the real accounts. *Narrative* would be a more fitting name than *nominal* for accounts of this genus.

When we meditate on theory we must perforce consider these two kinds of accounts, but when our attention is directed towards practice our thoughts need not rise above their major subdivisions. Accounts to the laymen are either asset, liability, expense, or income. The first two are used to draw up balance sheets showing the values existing at a particular moment and the last two are used to draw income, profit and loss statements showing the causes which, since the last reckoning, have led up to the present situation. Asset and expense accounts appear on the books as debits; liability and income accounts appear on the books as credits.

Mixed Accounts.

Accounts are said to be mixed when dissimilar debit and credit entries, such as interest paid and interest received, are carried under one heading. They are also said to be mixed when a narrative or account showing cause contains at the end of the period a residual property value. This type can be closed only after the residual property value has been determined by physical count or by calculation. Avoiding the use of mixed accounts is certain to improve the technique.

Selecting General-ledger Accounts.

Often a bookkeeper thinks a particular account is useful and puts it in the general ledger regardless of its real value to the management. Later, having forgot his earlier thoughts, he diverts similar facts to some other heading. Such practices vitiate those long-term comparisons which are so essential to a good picture of real business costs. Accounts should be thought out carefully and used until cogent reasons make changes advisable. In James H. Bliss's book, "Management through Accounts" published by The Ronald Press Company, and in F. W. Kilduff's "Auditing and Accounting Handbook," published by the McGraw-Hill Book Company, Inc., will be found many constructive suggestions as to proper accounts.

General-ledger Accounts.

In order to demonstrate cost-accounting methods, a problem has been worked out in this book. The general-ledger accounts used in it are described in this chapter. They have been selected primarily to illustrate cost finding and only enough commercial accounts have been added to show the ease with which the two branches of accounting can be integrated into one system. Although the technique of cost determination easily can be standardized, the names of accounts always must remain highly individual with each industry and in each enterprise be subject to selective influences arising in the viewpoint of the owner. For this reason the accounts have been chosen not to depict a particular business but to make the problem comprehensive. Well-known accounts not used in this text have been interpolated, as it is felt that their inclusion will make the problem more easily understood.

In everyday life, the names by which business transactions are known have not been standardized. One speaks

TABLE II.—GENERAL-LEDGER ACCOUNTS[1]

1. Accounts Payable
2. Accounts Receivable
3. Administrative Expense
4. Advertising
5. Betterments
6. Buildings, Structures, etc.
7. Capital Stock
8. Cash
9. Cash Discount on Purchases
10. Cash Discount on Sales
11. Containers Returnable
12. Cost of Goods Sold
13. Cost of Miscellaneous Materials Sold
14. Cost Variation
15. Depreciation Accrued on Buildings, etc.
16. Depreciation Accrued on Plant
17. Discount to the Trade
18. Dividends Payable
19. Factory Supplies
20. Finished Stock
21. Fire Loss
22. Fixed Property for Sale
23. Fuel
24. General Expense
25. General Overhead
26. Insurance Unexpired, Fire
27. Insurance Unexpired, Miscellaneous
28. Interest Paid
29. Interest Received
30. Investments
31. Land
32. Liquidation Expense
33. Maintenance
34. Material in Transit
35. Material Received without Invoice
36. Mechanical Expense
37. Metered Supplies
38. New Construction
39. Notes Payable
40. Notes Receivable
41. Notes Receivable Discounted
42. Office Expense
43. Packing Supplies
44. Patents, Formulae, Design, etc.
45. Payroll
46. Plant
47. Process Costs
48. Profit and Loss
49. Raw Material
50. Raw Material Purchase Invoices
51. Raw Material Purchase Credits
52. Renewal of Buildings, etc.
53. Renewal of Plant
54. Repairs
55. Replacements
56. Reserve for Depreciation of Buildings, etc.
57. Reserve for Depreciation of Plant
58. Salaries
59. Sales
60. Sales Credits
61. Sales of Miscellaneous Materials
62. Salvage
63. Scrap
64. Selling Expense
65. Spare Parts
66. Surplus
67. Taxes
68. Technical Expense
69. Transportation Inbound
70. Transportation Outbound
71. Work in Process

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[1] The numbers prefixed to the accounts are used for identification purposes throughout the calculations in this book.

of a profit and loss account and another prefers to call the same thing a loss and gain account. It is impossible to neutralize the effects of this loose habit by listing the accounts either alphabetically or according to their classification as asset, liability, expense, and income. The last scheme is misleading, as some join different classes as the bookkeeping progresses. Consider a payroll account receiving a charge for wage payments weekly. If a statement is drawn concurrently with the expenditure, the account is of the expense type; but at all times between periods it is a mixed account because a deferred payment must be injected to complete the expense. Later it will be seen that the payroll account is always a liability after the cost accounts have been entered on the books, for at that time only the deferred element is presented. The general-ledger accounts are given in alphabetical order and are preceded by the index (Table II). The descriptive remarks show how the accounts are used in the problem worked out in this book.

GENERAL-LEDGER ACCOUNTS

1. *Accounts Payable* controls a detailed purchase ledger showing all money due vendors. Normally, with its balance on the credit side it shows a liability.

2. *Accounts Receivable* controls a detailed customers' ledger, showing all money due the company for goods sold. Normally, with its balance on the debit side it shows an asset.

3. *Administrative Expense* is used in the text instead of the better-known account General Expense, as it is felt that the change would make the cost calculations easier to understand. Administrative Expense should not be allowed to become a receptacle for the nondescript, but should be confined to those items which pertain to the general running of the business. To provide a proper account for every business transaction simply requires giving sufficient attention to this accounting detail.

4. *Advertising* in the problem, like Administrative Expense, is charged off completely each month in exact amount of the invoices received.

5. *Betterments* is a mixed account used to record the cost of fixed-property improvements. With work of this character, the final result must be compared with the cost of building a new unit of the same type to determine the existence of any excess value which must be written off as a loss before the cost of betterments can be transferred to the appropriate fixed-property account. For further information see page 215.

6. *Buildings, Structures, etc.* gives the total cost and controls a detailed ledger showing the separate cost of each building, structure, etc.

7. *Capital Stock* is used in the text to connote every type of capital structure.

8. *Cash* refers to all money used in the ordinary course of business. On the general ledger, the values are kept in account with the bank of deposit. By using different banks special funds can be kept apart. Petty cash can be handled through its own account or by the more modern impressed system of vouchering checks in exact amount of petty-cash expenditures.

9. *Cash Discount on Purchases* is not used as an account by some people, as they claim such allowances should be deducted from the invoice to reduce an overstated cost. In the text, Cash Discount on Purchases is treated as an increment of income.

10. *Cash Discount on Sales* shows the total of these allowances so that the amount can be deducted from the sales income.

11. *Containers Returnable* is a necessary account in those industries which receive goods in expensive returnable packages. Usually drums, cylinders, barrels, carboys, etc. are paid for as received, full credit being allowed when they are returned within a 90-day period. The general-ledger account should be well supported by detailed records. A separate perpetual inventory sheet like that shown in Fig. 20 should be used for each type of container received from each shipper. The values can be entered in the Remarks column. It is advisable to charge a percentage of the value to the appropriate raw-material account to cover breakage and other losses. A rigid control is essential if losses are to be kept within bounds. Similar containers used for shipping goods should be charged to a different account of the same general type.

12. *Cost of Goods Sold* is an account used to set up on the general ledger the results of calculations made for this purpose.

13. *Cost of Miscellaneous Materials Sold* is an account used to establish the profit or loss on unusual transactions which are not a part of the regular business affairs. When surplus raw materials are liquidated, they must be transferred to this account at cost. Similarly, old machinery for sale inventoried at a fixed price, as it is sold, must be charged to this account at that value.

14. *Cost Variation* is an account used to adjust differences between standard and actual costs. Debit balances show losses, and credit balances indicate performance to be superior to type conditions.

15. *Depreciation Accrued on Buildings, etc.* as an account makes it possible to enter monthly depreciation charges on the books without interfering with the annual postings to the depreciation reserve account. More information on this will be found on page 211.

16. *Depreciation Accrued on Plant* is an account of the same character as Depreciation Accrued on Buildings.

17. *Discount to the Trade* sets up on the books the cost of selling goods through jobbers. To be of value this information must be supplemented by the gross sales on which the discount has been allowed.

18. *Dividends Payable* sets up as a liability any dividends declared by the directors.

19. *Factory Supplies* covers sundry materials such as brooms, oil, waste, etc. used incidentally in production.

20. *Finished Stock* states the inventory of finished goods on hand and clears all transactions in them.

21. *Fire Loss* accounts are needed to adjust the books in accordance with the effects of a fire. Further information on this will be found on page 218.

22. *Fixed Property for Sale* inventories, abandoned machinery, and other fixed property which as yet has not been marketed. The use of this account will be more fully understood after the article on Scrapped Plant in Chap. XVIII has been studied.

23. *Fuel* is an account used to express the inventory, the purchase, and the consumption of coal or its substitutes.

24. *General Expense* has been replaced in the text by the account Administrative Expense.

25. *General Overhead* sets up on the general ledger the total of administrative, sales, office, and warehouse costs given by the calculations.

26. *Insurance Unexpired, Fire,* is used to show fire-insurance costs and to state the value of prepaid premiums.

27. *Insurance Unexpired, Miscellaneous,* is used to show the various liability insurance costs and to state the value of prepaid premiums. Under this heading are carried such items as employees' liability, payroll, elevator, public liability, boiler explosion, etc.

28. *Interest Paid* connotes all interest payments.

29. *Interest Received* connotes all interest received, such as on bank balances, etc.

30. *Investments* refers to funds tied up in bonds, securities of other corporations, etc.

31. *Land* states the value of land owned by the company, together with all improvements.

32. *Liquidation Expense* is an account used to clarify the entries related to scrapped fixed property. This subject is discussed on page 218.

33. *Maintenance* is not used in the text as all such work is done by the company's own men and is charged through the mechanical department (see p. 216).

34. *Material in Transit* sets up on the general ledger each month the value of material which has not been received, although the invoice for it has been entered on the records.

35. *Material Received without Invoice* is an account used at the end of the month to show as a deferred charge the value of material which has been received, although the invoice for it is not available for entry on the records. This account is particularly valuable when it is desired to close the books promptly, as is the case with cost work. Bookkeepers often wait a few days to get belated bills, but if the account Material Received without Invoice is used, they can rule off their purchase journal promptly at the end of the month and still keep the statistical and financial records in harmony.

36. *Mechanical Expense* obviates an expensive material control for nuts, bolts, nails, sandpaper, and other nondescript articles which can be accounted for without serious error by assuming their use in direct proportion to the labor hours of mechanical activity. Each month the exact amount of the Mechanical Expense invoices is charged to the mechanical department.

37. *Metered Supplies* is a ledger account for gas, water, electricity, etc. purchased from outside sources. It shows the amount purchased and sets up the amount used from the date of invoice until the end of the month as an accrued charge.

38. *New Construction* is the proper account for the original entry of the cost of new or additional fixed property. When the construction work is completed, the value is transferred to the appropriate property account. Further information will be found on pages 19 and 211.

39. *Notes Payable* records money borrowed on notes.

40. *Notes Receivable* records money loaned on notes.

41. *Notes Receivable Discounted* expresses the contingent liability of discounted notes receivable.

42. *Office Expense* expresses the cost of office supplies, stationery, postage, telephone service, telegrams, etc.

Unless the supplies run into large figures, it is an unnecessary refinement to inventory them. They have no market value and, as a rule, can be safely charged to operations in the full amount of the month's invoices.

43. *Packing Supplies*, such as barrels, cases, paper, twine, etc., in many manufactures can be separated advantageously from factory supplies. Package costs easily mount up and need considerable thought to be reduced to minimum figures.

44. *Patents, Formulae, Design, etc.* is used in the text as a generic term for all intangible assets.

45. *Payroll* states the wage payments, and, after the cost entries have been made, reports the amount due until the end of the month as an accrued charge.

46. *Plant* controls a subsidiary ledger showing the first cost of such items as furniture, equipment, machinery, etc., constituting the fixed investment of this character. Further information will be found on page 200.

47. *Process Costs* is an account used to simplify the journal entries for the cost calculations.

48. *Profit and Loss* is the account which periodically shows the net result of all the business transactions. Debits are losses and credits are profits.

49. *Raw Material* is used not only to state inventories but also to clear all raw-material values pertaining to purchases, consumption, etc.

50. *Raw-material Purchase Invoices* is charged with the gross value of all bills for raw materials, freight, express, cartage, and other expenses made for their benefit. The only credit entry made in this account is the one necessary to transfer the invoices for the month to the Raw Material account.

51. *Raw-material Purchase Credits* is used for all credits and allowances on raw material purchases.

52. *Renewal of Buildings, etc.* states the total cost to date of renewals to buildings, structures, etc. The account is entered on statements as a charge against depreciation reserve. In other words, the first cost, less depreciation reserve, plus renewals, gives the present book value of the buildings. For further information, see page 216.

53. *Renewal of Plant* is an account of the same character as the preceding one. To it is charged the cost of renewed parts. When an entire machine is replaced, it is more satisfactory to substitute, for the original cost, depreciation reserve and renewals, the new first cost and start depreciating anew. Of course, this method requires detailed fixed-property records. For further information, see page 216.

54. *Repairs*, in the text, is used only for repairs made by people who are not in the employ of the company. For further information, see page 216.

55. *Replacements* is an account of the same character as New Construction. Its values can be transferred to the fixed property records only after the original cost data on the unit replaced has been removed. For further information, see page 216.

56. *Reserve for Depreciation of Buildings, etc.*, differs from the Depreciation Accrued account in that it receives only annual charges. For further information, see page 211.

57. *Reserve for Depreciation of Plant* is similar to the preceding account and also is more fully described in Chap. XVIII.

58. *Salaries* is an account used to record the monthly payments for services usually made by check to the more important employees.

59. *Sales* is the controlling account showing the gross sales of finished goods and other articles which constitute the regular trading stock of the company.

60. *Sales Credits* is used to record all credits and allowances on regular sales. With major accounts like this it is usually better not to place the sales and sales credits in one account.

61. *Sales of Miscellaneous Materials* shows the sales of those assorted items which occur in every business and

which are not properly a part of the regular sales account. These transactions are usually reported in an auxiliary book which at the end of the month is analyzed to show the amount chargeable to scrap, salvage, and miscellaneous materials. Under the last heading are placed such things as surplus raw material, old-machinery inventories in the Fixed Property For Sale account, etc. Credits and allowances to this account are not kept separately.

62. *Salvage* is an account used to hold incoming values from the sale of scrapped fixed property until such time as it is convenient to figure the loss incurred. When a fixed-property sale appears in the auxiliary sales book, the value is transferred to the Salvage account if the item is not recorded on the inventory of Fixed Property for Sale. This procedure prevents the bookkeeper from committing an accounting trespass in the domain of the fixed-property records and yet permits him to close his books without waiting on someone else's convenience for needed information. Also see page 217.

63. *Scrap* shows the values received from the sale of old iron, barrels, bags, etc., which always accumulate in the course of factory operations.

64. *Selling Expense* states the expenses incurred through the sale of goods. The full amount of each month's vouchers is charged to operations.

65. *Spare Parts* is used to separate the stock of parts for renewals and for new machines from the supply accounts.

66. *Surplus* is used as a general term to represent appropriated surplus and undivided profits.

67. *Taxes* is an account used to show the local taxes paid during the year and at the end of each month the amount of tax which has accrued or has been prepaid.

68. *Technical Expense* is used in the text to connote engineering, chemical, or other supplies of this character. Many manufacturing enterprises require the services of one or more of these technical departments. As with office supplies, the total invoices of the month can be charged off, for generally it is an unnecessary refinement to inventory the unconsumed balance of supplies.

69. *Transportation Inbound* in the form of freight, cartage, etc., is not obtained separately in the text, all such services being charged direct to the account benefited.

70. *Transportation Outbound* shows the value of such services rendered gratis to customers. Each month the amount is written off as a sales expense. Only invoices of outside concerns are charged to this account as similar work done by the company's own trucks is transferred to General Overhead through the cost calculations.

71. *Work in Process* is used to state the inventories of unfinished goods and to show the cost of producing finished goods.

PART II

DETERMINING PROCESS COSTS

CHAPTER IV

DEPARTMENTAL COST ELEMENTS

Data for an Illustrative Problem.

As the exposition of cost-finding methods is made clearer by attacking a specific problem, data for this is presented here. The reader is advised to follow the figures carefully, for no casual reading of theory will ever bring mastery of a subject with the structural intricacies of cost accounting. The accounts and values have been selected to secure the widest possible application and not to represent a particular business. These values will be followed through all the stages of accounting, including a re-entry into the general ledger, and also will be used to prepare financial statements. The contributing facts, obtained from the factory records, will be introduced as needed at the point of discussion. The ledger accounts used here have all been defined in Chap. III. The initial facts for the problem are given in:

1. A trial balance taken on Dec. 31, 1926, after closing the books (Table III).
2. Complete journal entries for the month of January, 1927, *i.e.*, the figures from the purchase invoice book, the cash book, the sales book, the miscellaneous sales book, and the credit books (Table IV).
3. A trial balance of the general ledger after posting the January, 1927, accounts (Table V).

TABLE III.—TRIAL BALANCE, DEC. 31, 1926[1]

No.	Title	Dr.	Cr.
1.	Accounts Payable		$ 32,777.58
2.	Accounts Receivable	$ 75,692.01	
6.	Buildings, Structures, etc	181,766.09	
7.	Capital Stock		500,000.00
8.	Cash	40,890.16	
11.	Containers Returnable	1,280.00	
19.	Factory Supplies	2,361.68	
20.	Finished Stock	78,688.83	
22.	Fixed Property for Sale	1,872.00	
23.	Fuel	1,410.15	
26.	Insurance Unexpired, Fire	4,508.27	
27.	Insurance Unexpired, Miscellaneous	105.11	
30.	Investments	25,000.00	
31.	Land	33,491.80	
34.	Material in Transit	201.19	
35.	Material Received without Invoice		58.95
37.	Metered Supplies		186.13
38.	New Construction	5,897.18	
43.	Packing Supplies	1,489.61	
44.	Patents, Formulae, Design, etc	10,000.00	
46.	Plant	254,801.56	
49.	Raw Material	33,676.37	
52.	Renewal of Buildings, etc	4,202.77	
53.	Renewal of Plant	33,651.03	
56.	Reserve for Depreciation of Buildings, etc.		38,652.71
57.	Reserve for Depreciation of Plant		101,001.89
65.	Spare Parts	3,782.59	
66.	Surplus		185,798.21
71.	Work in Process	63,707.07	
		$858,475.47	$858,475.47

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[1] In Table XXV these values will be found posted to ledger accounts.

TABLE IV.—JOURNAL ENTRIES, JANUARY, 1927[1]

Purchase Invoice Book

No.	Account	Dr.	Cr.
3.	Administrative Expense	$ 956.25	
4.	Advertising	1,190.00	
11.	Containers Returnable	1,510.00	
19.	Factory Supplies	190.70	
23.	Fuel	758.65	
26.	Insurance Unexpired, Fire	1,508.94	
27.	Insurance Unexpired, Miscellaneous	1,125.30	
32.	Liquidation Expense	750.00	
36.	Mechanical Expense	75.33	
37.	Metered Supplies	557.53	
38.	New Construction	2,580.72	
42.	Office Expense	124.60	
43.	Packing Supplies	158.95	
50.	Raw Material Purchase Invoices	25,875.90	
53.	Renewal of Plant	486.57	
54.	Repairs	250.00	
64.	Selling Expense	586.82	
65.	Spare Parts	51.08	
68.	Technical Expense	175.11	
70.	Transportation Outbound	248.79	
1.	Accounts Payable		$39,161.24
		$39,161.24	$39,161.24

Cash Book

Receipts

No.	Account	Dr.	Cr.
8.	Cash	$61,850.25	
10.	Cash Discount on Sales	238.20	
29.	Interest Received		$ 55.22
2.	Accounts Receivable		62,033.23
	Totals	$62,088.45	$62,088.45

Disbursements

No.	Account	Dr.	Cr.
1.	Accounts Payable	$36,008.97	
45.	Payroll	15,672.20	
58.	Salaries	3,966.67	
8.	Cash		$55,281.93
9.	Cash Discount on Purchases		365.91
		$55,647.84	$55,647.84

TABLE IV.—JOURNAL ENTRIES, JANUARY, 1927.—(*Continued*)

Sales Book

No.	Account	Dr.	Cr.
59.	Sales		$63,719.83
17.	Discount to the Trade	$ 1,177.90	
2.	Accounts Receivable	62,541.93	
	Totals	$63,719.83	$63,719.83

Miscellaneous Sales Book

No.	Account	Dr.	Cr.
11.	Containers Returnable		$1,050.00
61.	Sales of Miscellaneous Materials		1,820.60
62.	Salvage		350.00
63.	Scrap		98.21
2.	Accounts Receivable	$3,318.81	
	Totals	$3,318.81	$3,318.81

Credit Books

No.	Account	Dr.	Cr.
60.	Sales Credits	$799.40	
2.	Accounts Receivable		$799.40
51.	Raw Material Purchase Credits		88.50
19.	Factory Supplies		1.19
1.	Accounts Payable	89.69	
	Totals	$889.09	$889.09

[1] In Table XXV these values will be found posted to ledger accounts.

TABLE V.—TRIAL BALANCE, JAN. 31, 1927

No.		Dr.	Cr.
1.	Accounts Payable		$ 35,840.16
2.	Accounts Receivable	$ 78,720.12	
3.	Administrative Expense	956.25	
4.	Advertising	1,190.00	
6.	Buildings, Structures, etc	181,766.09	
7.	Capital Stock		500,000.00
8.	Cash	47,458.48	
9.	Cash Discount on Purchases		365.91
10.	Cash Discount on Sales	238.20	
11.	Containers Returnable	1,740.00	
17.	Discount to the Trade	1,177.90	
19.	Factory Supplies	2,551.19	
20.	Finished Stock	78,688.83	
22.	Fixed Property for Sale	1,872.00	
23.	Fuel	2,168.80	
26.	Insurance Unexpired, Fire	6,017.21	
27.	Insurance Unexpired, Miscellaneous	1,230.41	
29.	Interest Received		55.22

TABLE V.—TRIAL BALANCE, JANUARY 31, 1927.—(*Continued*)

No.		Dr.	Cr.
30.	Investments	25,000.00	
31.	Land	33,491.80	
32.	Liquidation Expense	750.00	
34.	Material in Transit	201.19	
35.	Material Received without Invoice		58.95
36.	Mechanical Expense	75.33	
37.	Metered Supplies	371.40	
38.	New Construction	8,477.90	
42.	Office Expense	124.60	
43.	Packing Supplies	1,648.56	
44.	Patents, Formulae, Design, etc.	10,000.00	
45.	Payroll	15,672.20	
46.	Plant	254,801.56	
49.	Raw Material	33,676.37	
50.	Raw Material Purchase Invoices	25,875.90	
51.	Raw Material Purchase Credits		88.50
52.	Renewal of Buildings, etc	4,202.77	
53.	Renewal of Plant	34,137.60	
54.	Repairs	250.00	
56.	Reserve for Depreciation of Buildings, etc.		38,652.71
57.	Reserve for Depreciation of Plant		101,001.89
58.	Salaries	3,966.67	
59.	Sales		63,719.83
60.	Sales Credits	799.40	
61.	Sales of Miscellaneous Materials		1,820.60
62.	Salvage		350.00
63.	Scrap		98.21
64.	Selling Expense	586.82	
65.	Spare Parts	3,833.67	
66.	Surplus		185,798.21
68.	Technical Expense	175.11	
70.	Transportation Outbound	248.79	
71.	Work in Process	63,707.07	
	Total	$927,850.19	$927,850.19

The Departmental Cost Elements.

Cost accounting owes its existence to the desire to know actual article costs. To get article costs we must determine process costs; to get process costs we must determine departmental costs; and to get departmental costs we must determine what part of our expenses, for the period under consideration, is caused by departmental functions, active or potential. As these values are not given as such in any of the existing books of record, we must do the field work necessary to secure them and then, for our own convenience, we must tabulate them so that the established charges for departmental activities are instantly available for all subsequent calculations.

In this chapter we are only concerned with the values which must be credited to the general ledger accounts so that the cost of running the business for the month of January can be separated from the commercial accounts. The distribution of these accounts to departments does not enter into this phase of the work.

Sources of the Cost Elements.

The cost elements used in the tabulation originate in three ways. There are those that come through calculations, as for depreciation; those that come through factory records, as on requisitions for supplies, time cards for labor, etc.; and those that come direct from invoices, as is the case with many of the expenses. A duplicate set of bills stapled together in groups, each group showing the derivation of a monthly ledger entry will be found to be an unusual time saver in subsequent analytical investigations. If they are placed in letter-sized manila envelopes, remarks as to their distribution can be written on the face of the folder without danger of being lost.

The Tabulation Sheet.

The tabulation of the departmental cost elements must attain a maximum of utility. If it is designed to make good contacts with the general ledger and with the departmental cost-distribution sheet, it serves its major purpose. To join together with the ledger it must use the same accounts and to join together with the distribution sheet it must arrange the accounts into serviceable groups. The distribution sheet becomes unwieldy if the accounts are not entered on it in condensed form. On going over the long list of expenditures, we find that they can be arranged into six serviceable groups:

1. Depreciation.
2. Taxes and fire insurance.
3. Other expenses.
4. Supplies.
5. Fuel.
6. Payments for human services.

There are other arrangements which can be used. The various expenditures, however, have inherent characteristics which suggest satisfactory combinations. Depreciation differs from the other items in that it involves no immediate outgo of cash, although it does foreshadow an ultimate day of reckoning. Being a quasi surplus on which the business can feed until the slow process of starvation has done its deadly work, and being, as to proper amount in the final analysis, largely a matter of opinion, depreciation should be entered separately in the cost calculations. Taxes and fire insurance are joined together because they both yield fixed values which can be settled by an annual calculation. Other expense groups accounts which, in nearly every case, can be assigned in total to a particular department. Supplies can be determined only by taking an inventory or through a requisition system. Fuel is in a class by itself. Payments for human services should stand apart as in one sense they constitute fugitive cost elements.

Tabulation Entries.

Table VI shows, in terms of general-ledger accounts, conveniently arranged for use on the distribution sheet, the cost of running the business during the month of January, 1927. In the succeeding paragraphs the origin of the various entries is discussed. The accounts and values are intended to suggest a serviceable technique and not to dictate an exclusive procedure. The exact methods used should be modified to conform to local conditions.

For instance, the number of accounting groups can be increased or decreased; but it should be recognized that the underlying motive is to present a picture which is thoroughly instructive, yet not too expansive.

TABLE VI.—TABULATION OF DEPARTMENTAL COST ELEMENTS, JANUARY, 1927[1]

Column group number	Account	January	
		Amount	Totals
	Depreciation of Buildings	$ 757.35	
	Depreciation of Plant	3,185.02	
1	Total Depreciation		$ 3,942.37
	Taxes	720.00	
	Fire Insurance	812.50	
2	Total Taxes and Insurance		1,532.50
	Administrative Expense	956.25	
	Advertising	1,190.00	
	Insurance, Miscellaneous	487.42	
	Mechanical Expense	75.33	
	Office Expense	124.60	
	Repairs	250.00	
	Selling Expense	586.82	
	Technical Expense	175.11	
	Transportation Outbound	248.79	
3	Total Expense		4,094.32
	Factory Supplies	288.90	
	Metered Supplies	552.29	
	Packing Supplies	760.02	
	Raw Material as a Supply	37.98	
	Finished Stock as a Supply	75.42	
4	Total Supplies		1,714.61
	Fuel	634.43	
5	Total Fuel		634.43
	Payroll	16,296.17	
	Salaries	3,966.67	
6	Total Payroll and Salaries		20,262.84
16	Total Departmental Costs		$32,181.07

[1] This tabulation can be set up conveniently on the form shown in Figs. 4 or 35. The initial distribution of these values to departments is shown in Fig. 5 and the final distribution in Fig. 6.

Either Fig. 4 or 35 will provide a serviceable form for permanently tabulating the cost elements. Two columns are required for posting the values because the group and grand totals must be shown in addition to the separate entries for each general-ledger account. The six groups of accounts are called *column groups* because they furnish the connecting links between the columns of the distribution sheet (Fig. 5) and the accounts in the tabulation (Table VI).

Depreciation.

Since there is no entry for it in the general ledger, the accrued depreciation for January must be calculated (see page 211). One month on buildings at the rate of 5 per cent per annum of the book value amounts to $757.35 and 1 month on plant at the rate of 15 per cent per annum amounts to $3,185.02. To take an average percentage on the first cost is a popular, but not a good way of figuring depreciation. It is used here to simplify the problem. Depreciation is given further consideration in Chap. XVIII on fixed-property accounting, where more correct methods of making these calculations are discussed.

Taxes and Fire Insurance.

Taxes has reference to the local imposts levied on real estate and personal property. Since the invoice for this has not been received and the exact amount is not known, the January accrual will have to be figured on the same basis as the taxes for 1926. The previous assessment was $120,000 on real estate and $120,000 on personal property. The rate was $3.60 per $100 of valuation. According to these figures the tax element for January, 1927, works out to $720.

Fire-insurance policies on buildings, plant, and stock amount to $650,000 with an average premium of $1.50 per $100 of insurable value. At this point only the net premium is of interest; further details on the fire insurance policies will be found on page 62. The fire-insurance cost element for January, 1927, is $812.50.

Other Expenses.

With the exception of miscellaneous insurance, all of the other expense items are charged to the tabulation in exact amount of the January invoices. If the duplicate file suggested on page 50 is employed, the precise nature of each account can be quickly established. Often, it is desirable to subdivide each expense account into appropriate groups and summarize the expenditures for the year in an auxiliary record. In Chap. III it was pointed out that office and similar supplies must be on hand in substantial amounts before it is worth while to carry an inventory for them on the books. Treating such items as an expense means that the net amount of the invoices for the month must be entered on the cost sheet.

Investigating miscellaneous insurance, we find that an advance three months' premium has been deposited to cover employees' liability. At an average rate of $2.00 per $100 of payroll, the January cost on a payroll of $16,296.17 amounts to $325.92. Since the annual premiums for public liability, elevator hazard, payroll protection, and boiler explosion are small, the entire amounts are charged in during this month. The separate charges for miscellaneous insurance during January are as follows:

Employees' Liability	$325.92
Public Liability	40.00
Elevator Liability	43.52
Payroll Protection	42.80
Boiler Explosion	35.18
Total Miscellaneous Insurance	$487.42

Supplies.

According to requisitions, the factory supplies used during January amounted to $288.90; the packing supplies to $760.02; raw material used non-productively by the Technical Department to $37.98; and free samples of finished stock given away to $75.42. More information on the requisition system for supplies will be found on page 64.

The metered supplies components—gas, electricity, and water—are billed on invoices rendered on the first of the month for consumption up to the twentieth of the month. It is necessary, therefore, to read the gas, electric, and water meters to determine the amount used up to the end of the month. The average unit price on the invoice is used more conveniently in figuring accruals than the sliding-scale values on which these commodities are sold. In Table VII the cost data are adjusted to agree with the calendar month; metered supplies amounting to $552.29 were consumed during January.

TABLE VII.—METERED SUPPLIES COST DATA ON GAS, ELECTRICITY, AND WATER

Metered Supplies	Dec. 31, 1926, accrual	January, 1927, invoices	Jan. 20 to 31, 1927 accrual	Consumption costs
Gas	$ 4.08	$ 12.68	$ 4.21	$ 12.81
Electricity	169.20	507.97	164.58	503.35
Water	12.85	36.88	12.10	36.13
Totals	$186.13	$557.53	$180.89	$552.29

237
130
36[illegible]
[illegible]
90½ ✓

Fuel.

To establish the cost of the coal used, the entire fuel account must be balanced. At the end of the year there was on hand 237 tons; during January 130 tons were received; requisitions show Production Department A used 16½ tons during the month; measurements of the stock pile and the power-house bin indicate an inventory of 260½ tons. By difference the power-house consumption works out to 90 tons.

The initial inventory was valued at $5.95 a ton. January receipts with all freight charges cost $5.8356 per ton. The transportation department spent 24 hours at the coal elevator unloading the cars. The cost of this labor at the standard rate of 65 cents an hour, amounting to $15.60, could be charged direct to the power house, but a truer picture is obtained by entering the sum in the fuel account. Although the average cost of the fuel, unloaded, is a little over $5.95 per ton, the even figure can be used as the difference is within the limits of accuracy of the established inventory. For the same reason, the deficit of 75 cents can properly be charged off to power-house operations. The detailed account is written on a letter-sized manila envelope in which the various vouchers are filed. The three items, $98.18, $535.50, and $0.75 make up the January fuel charge of $634.43. The complete fuel account is given in Table VIII.

TABLE VIII.—FUEL ACCOUNT, JANUARY, 1927

Date	Tons	Item	Price	Amount	Date	Tons	Item	Price	Amount
1926 Dec. 31	237	Inventory	$5.95	$1,410.15	1927 Jan. 31	16½	Product Department A	$5.95	$ 98.18
						90	Power house	5.95	535.50
1927 Jan. 31	130	Received	.....	758.65			Power house	.....	.75
		Unloading	.....	15.60		260½	Inventory	5.95	1,549.97
	367	....	.....	$2,184.40		367	....	.....	$2,184.40
Jan. 31	260½	Inventory	$5.95	$1,549.97					

Payroll and Salaries.

As the company paid its employees on Saturday, Jan. 29, for the past week, the ledger entry of $15,672.20 must be supplemented by $623.97, the amount of the payroll for Monday, January 31, to get $16,296.17, the total charge for the month. The salary account for January is correct as entered on the books at $3,966.67.

Values Which Should Not Be Entered on the Tabulation Sheet.

As it is the object of the tabulation to determine the cost of departmental activities for a subsequent derivation of the pure process element of article costs, the value of raw

materials used in the production of saleable goods should not be included here. A similar restriction holds for machinery, equipment, direct materials etc. which enter into new construction, the fabrication of spare parts, etc. Raw materials used as supplies, finished stock given away as samples, etc. must, however, be incorporated in the tabulation of cost elements.

CHAPTER V

DISTRIBUTING COSTS TO DEPARTMENTS

The Tabulation Sheet and the Distribution Sheet.

On the tabulation sheet of Chap. IV we have set up the departmental cost elements. We have circumscribed the sphere of process costs. On the distribution sheet the established values are recrystallised into departmental costs without adding to or subtracting from the sum total. The two sheets must agree to the penny at every related point.

Object of the Distribution Sheet.

In an ideal cost system all calculations would be so made that they can be reviewed at some later day without wasting an iota of time. The need for this becomes patent when we contemplate the long return journey from integrated unit-article costs to the original elemental sources. Who can safely say his costs will never be high and that, therefore, he will never have to make such a tedious backward search for underlying causes? It comes to all and when it comes, then to understand means to analyse. By showing the distribution of departmental costs on one sheet we reach out after ideal methods and conduct our calculations so that their accuracy can easily be attested.

Accounting Principle of the Distribution Sheet.

The basic principle of the distribution sheet is very simple. To set up departmental costs we must charge each department with the values which have accrued through its activities and we must credit each elemental source an equal amount. In other words, a debit and a credit entry is involved. There is a neat way of making these two

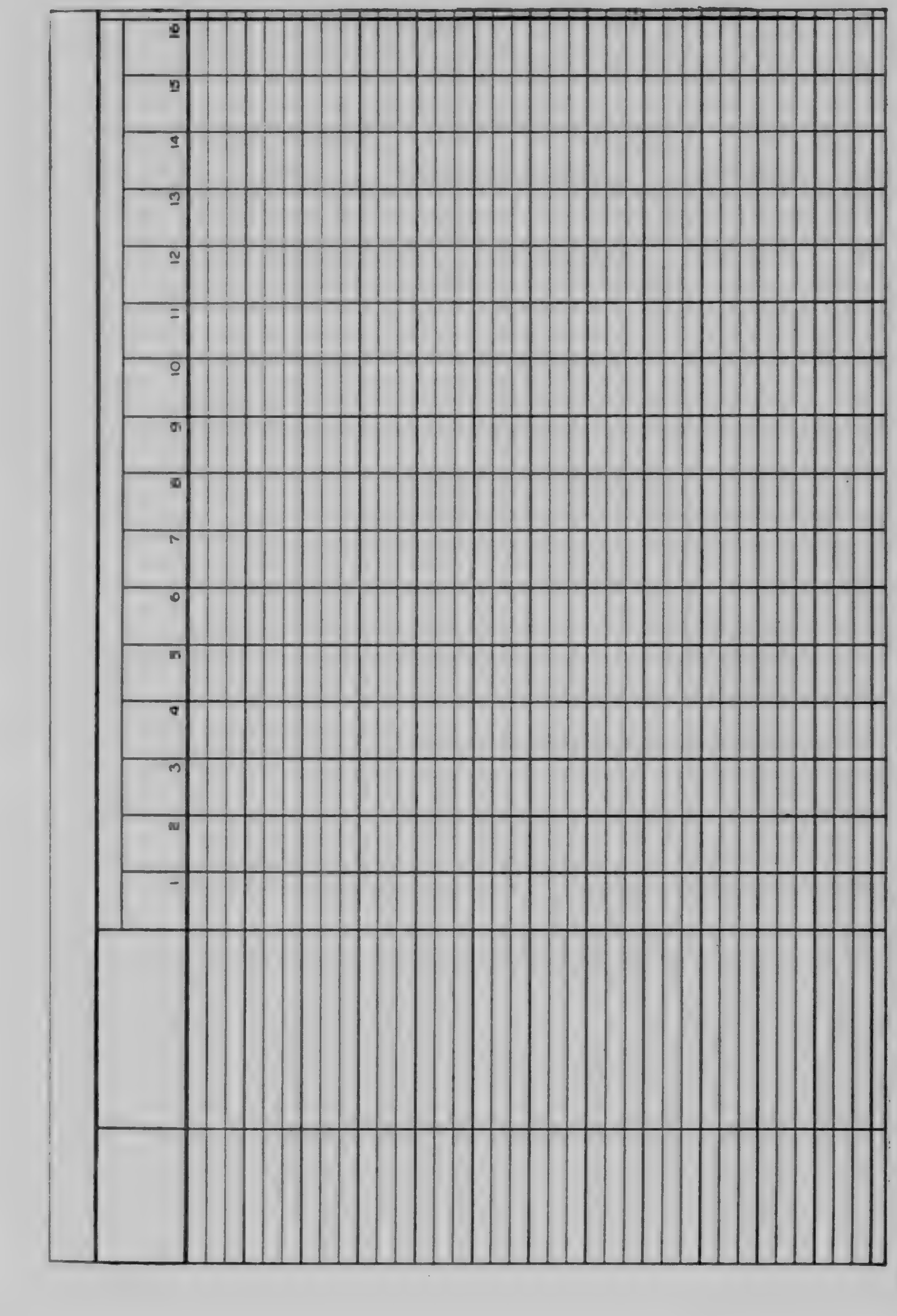
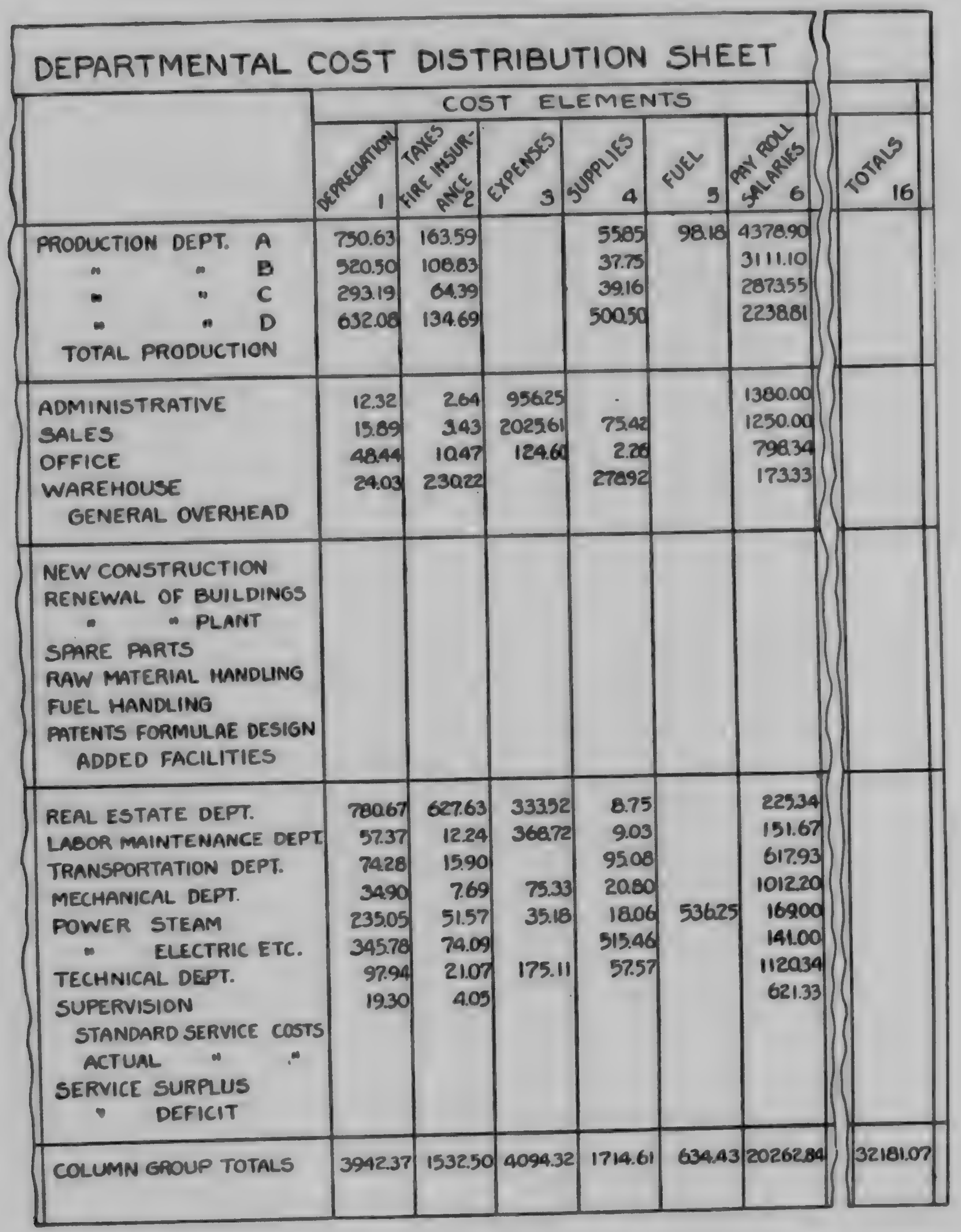


FIG. 4.—A columnar cost accounting sheet. This form is used for the calculations shown in Figs. 5, 6, 10, 17, 18, 28, 31, and 34.



DEPARTMENTAL COST DISTRIBUTION SHEET

	COST ELEMENTS						
	DEPRECIATION 1	TAXES FIRE INSURANCE 2	EXPENSES 3	SUPPLIES 4	FUEL 5	PAY ROLL SALARIES 6	TOTALS 16
PRODUCTION DEPT. A	750.63	163.59		55.85	98.18	4378.90	
" " B	520.50	108.83		37.75		3111.10	
" " C	293.19	64.39		39.16		2873.55	
" " D	632.08	134.69		500.50		2238.81	
TOTAL PRODUCTION							
ADMINISTRATIVE	12.32	2.64	956.25	.		1380.00	
SALES	15.89	3.43	2025.61	75.42		1250.00	
OFFICE	48.44	10.47	124.60	2.26		798.34	
WAREHOUSE	24.03	230.22		278.92		173.33	
GENERAL OVERHEAD							
NEW CONSTRUCTION							
RENEWAL OF BUILDINGS							
" " PLANT							
SPARE PARTS							
RAW MATERIAL HANDLING							
FUEL HANDLING							
PATENTS FORMULAE DESIGN							
ADDED FACILITIES							
REAL ESTATE DEPT.	780.67	627.63	333.52	8.75		225.34	
LABOR MAINTENANCE DEPT.	57.37	12.24	368.72	9.03		151.67	
TRANSPORTATION DEPT.	74.28	15.90		95.08		617.93	
MECHANICAL DEPT.	34.90	7.69	75.33	20.80		1012.20	
POWER STEAM	235.05	51.57	35.18	18.06	536.25	1690.00	
" ELECTRIC ETC.	345.78	74.09		515.46		141.00	
TECHNICAL DEPT.	97.94	21.07	175.11	57.57		1120.34	
SUPERVISION	19.30	4.05				621.33	
STANDARD SERVICE COSTS							
ACTUAL " "							
SERVICE SURPLUS							
" DEFICIT							
COLUMN GROUP TOTALS	3942.37	1532.50	4094.32	1714.61	634.43	20262.84	32181.07

Fig. 5.—Initial entries on the departmental cost distribution sheet, January, 1927. This represents a portion of Fig. 4 and shows the first stage in the development of the departmental cost distribution sheet.

entries without using more than a single figure. If, on a sheet of columnar paper we write the names of departments on the horizontal lines and the names of general ledger accounts in the columns then all we have to do to satisfy accounting technique is to assume each figure exists as a credit to the elemental source named at the top of the column and as a charge against the department found on the same horizontal line. The theory of the distribution sheet is more fully discussed on page 70.

The Initial Entries on the Distribution Sheet.

Figure 4 illustrates the columnar paper used for this work and Fig. 5 shows how the distribution sheet looks immediately after the initial entries have been made. The totals of columns 1, 2, 3, 4, 5, 6, 16 must agree with the respective column group totals and the grand total on the tabulation sheet (Table VI). The manner of making the original entries will be discussed in detail in the succeeding paragraphs. Other principles of distribution, which, under particular conditions, may seem more desirable, can be substituted for those used here without in the least affecting the fundamental technique.

Depreciation, Column 1 Entries.

As it is desired to bring building-maintenance costs to a separate focus, the entire building depreciation for January, 5 per cent per annum on $181,766.09 or $757.35, is charged to the Real Estate Department. Adding $23.32, the depreciation on plant items belonging to the Real Estate Department gives the total entry of $780.67. The individual building factors are taken up on page 79.

According to the fixed-property records, as of Dec. 31, 1926, the various departments are charged, at first cost, with the plant values given in Table IX. To simplify the problem, 15 per cent per annum is used to get the accrued plant depreciations for January shown in Table IX. Unless radical changes are made in the units, these values can be used throughout the year; any minor differences can be absorbed by an annual adjusting entry to the account, Cost Variation.

TABLE IX.—PLANT-DEPRECIATION CALCULATIONS[1]

Department	First cost	Monthly depreciation
Production Department A	$ 60,050.34	$ 750.63
Production Department B	41,640.46	520.50
Production Department C	23,455.63	293.19
Production Department D	50,566.38	632.08
Administrative Department	985.88	12.32
Sales Department	1,271.61	15.89
Office	3,875.15	48.44
Warehouse Department	1,922.08	24.03
Real Estate Department	1,865.35	23.32
Labor Maintenance Department	4,589.70	57.37
Transportation Department	5,942.48	74.28
Mechanical Department	2,791.93	34.90
Power: Steam	18,803.50	235.05
Power: Electric, etc	27,661.67	345.78
Technical Department	7,835.22	97.94
Supervision	1,544.18	19.30
Totals	$254,801.56	$3,185.02

[1] These depreciation charges are used in column 1 on Figs. 5 and 6.

Taxes and Fire Insurance, Column 2 Entries.

As taxes and fire-insurance distributions can both be settled by a single annual calculation, the two elements have been combined into a single set of figures for entry in column 2. Personal taxes are charged to departments in ratio to their first-cost plant values; this money must be recovered through the sale of goods and there is as much logic in getting it that way as there is in using any other method. The total real-estate taxes are charged to that department; the final distribution of this sum is explained on page 79.

Fire insurance covers buildings, plant, and stock. The premiums should be charged according to the underwriters schedules so that especially hazardous products are properly penalized; but in the problem, for convenience, the average rate of $1.50 per $100 of insurable value is used. The coverage on stock charged to the warehouse is treated as a General Overhead item—to incorporate it with the raw-material costs, etc. would inject many tedious complications. The detailed calculations for column 2 are given in Table X.

TABLE X.—TAXES AND FIRE-INSURANCE CALCULATIONS[1]

Plant	First cost	Insurable value	Monthly		Taxes and fire-insurance totals
			Taxes	Fire insurance	
Production Department A	$ 60,050.34	$ 63,000.00	$ 84.84	$ 78.75	$ 163.59
Production Department B	41,640.46	40,000.00	58.83	50.00	108.83
Production Department C	23,455.63	25,000.00	33.14	31.25	64.39
Production Department D	50,566.38	50,600.00	71.44	63.25	134.69
Administrative Department	985.88	1,000.00	1.39	1.25	2.64
Sales Department	1,271.61	1,300.00	1.80	1.63	3.43
Office	3,875.15	4,000.00	5.47	5.00	10.47
Warehouse Department	1,922.08	2,000.00	2.72	2.50	5.22
Real Estate Department	1,865.35	2,000.00	2.63	2.50	5.13
Labor Maintenance Department	4,589.70	4,600.00	6.49	5.75	12.24
Transportation Department	5,942.48	6,000.00	8.40	7.50	15.90
Mechanical Department	2,791.93	3,000.00	3.94	3.75	7.69
Power: Steam	18,803.50	20,000.00	26.57	25.00	51.57
Power: Electric, etc	27,661.67	28,000.00	39.09	35.00	74.09
Technical Department	7,835.22	8,000.00	11.07	10.00	21.07
Supervision Department	1,544.18	1,500.00	2.18	1.87	4.05
	254,801.56	260,000.00	360.00	325.00	685.00
Buildings:					
Real Estate Department	$181,766.09	210,000.00	360.00	262.50	622.50
Stock:					
Warehouse Department	....	180,000.00	......	225.00	225.00
Totals	....	$650,000.00	$720.00	$812.50	$1,532.50

Taxes:
Real Estate, $120,000. Rate, $3.60 per $100.
Personal, $120,000. Rate, $3.60 per $100.
Fire-insurance, Average Rate, $1.50 per $100 insurable value.

[1] The taxes and fire-insurance totals are used in column 2, Figs. 5 and 6.

Other Expenses, Column 3 Entries.

The distribution of expenses given in Table XI for column 3 is self-explanatory.

TABLE XI.—THE EXPENSE CHARGES OF COLUMN 3

Administrative		$ 956.25
Sales:		
Advertising	$1,190.00	
Selling Expense	586.82	
Transportation Outbound	248.79	2,025.61
Office:		
Expense		124.60
Real Estate:		
Repairs	250.00	
Public Liability Insurance	40.00	
Elevator Insurance	43.52	333.52
Labor Maintenance:		
Employees' Liability Insurance	325.92	
Payroll Insurance	42.80	368.72
Mechanical:		
Expense		75.33
Power: Steam:		
Boiler Insurance		35.18
Technical:		
Expense		175.11
Total		4,094.32

Supplies, Column 4 Entries.

The topic of supplies raises one of the most miserable issues in the province of cost accounting. It is a common condition to find about three-quarters of the total supply costs contributed by about one-twentieth of the total number of items handled. Thus, a burdensome amount of detail is created by a relatively unimportant dollars-and-cents expenditure.

There is an easy, but not accurate to the penny, way out of these difficulties. It is a simple thing to keep a close check on the significant items. The nondescript can be grouped into a small number of classes, such as piping, painting, cleaning, etc., supplies. Each class is subdivided, not on an article, but on a strict price basis, using round numbers which are fairly representative of the cost of the articles over a long period. For the purposes of accounting, we would then think of all the articles within each class in terms of 5, 10, 15, etc., cents or any other set of values

which suit the situation. When the requisitions are tallied, only the total amount in every class charged to each department need be ascertained. Inventories can also be quickly taken on a class-cost basis. More exact information is always available through an analysis of the purchase invoices. The errors involved play a small part in the cost picture and these inaccuracies are more than offset by the reduction in bookkeeping costs.

Table XII shows the derivation of the supply charges for column 4. Letter-sized manila envelopes can again be used to good advantage, for the table can be written on the face and the vouchers or summaries of them can be filed inside. It is very important in cost accounting to have all basic statistics readily available so that questionable entries can be instantly investigated.

TABLE XII.—THE SUPPLY CHARGES OF COLUMN 4

Department	Factory	Metered supplies	Packing	Raw and finished stock	Totals
Production Department A	$ 55.85				$ 55.85
Production Department B	37.75				37.75
Production Department C	39.16				39.16
Production Department D	19.40		$481.10		500.50
Administrative					
Sales				$ 75.42	75.42
Office		$ 2.26			2.26
Warehouse			278.92		278.92
Real estate	8.75				8.75
Labor Maintenance		9.03			9.03
Transportation	95.08				95.08
Mechanical	20.80				20.80
Power: Steam		18.06			18.06
Power: Electric, etc	12.11	503.35			515.46
Technical		19.59		37.98	57.57
Supervision					
Totals	$288.90	$552.29	$760.02	$113.40	$1,714.61

In the problem, factory, packing, raw-material, and finished-stock supplies are issued on requisitions and are charged direct to departments, as shown in Table XII. Metered Supplies has three components, gas, electricity and water, (see Table VII for the cost data). Gas is all used by the technical department and is charged direct to it. The water distribution is estimated as office $2.26, labor maintenance $9.03, power—steam $18.06 and technical department $6.78. The total cost of electricity is charged to power—electric, etc.,—because the cost of electric power transmission in the factory is sufficient to make a cost focus at the consuming motor advisable.

Fuel, Column 5 Entries.

The fuel account was completely developed in Chap. IV (see p. 56).

Payroll and Salaries, Column 6 Entries.

The subject of payroll distributions will be discussed more fully in Chap. VI (see p. 82). At this point the only information of value is the total cost of the labor supplied to each department during the month of January. The salary distributions given below have been added to the payroll figures to obtain the entries for column 6.

SALARY DISTRIBUTION

Administrative	$1,250.00
Sales	1,250.00
Office	300.00
Technical	666.67
Supervision	500.00
Total	$3,966.67

Distributing Service Department Costs.

After the initial entries have been made and the distribution sheet, at the stage illustrated by Fig. 5, has been checked with the tabulation sheet (Table VI), no new values can be added. Completing the distribution sheet is entirely a matter of allocating the service costs to the other departments and accounts. Figure 6 shows the completed distribution sheet. If any difficulty is experienced in grasping the service distributions, the theory of the sheet, on page 70, should be studied.

Service departments present a real problem in distribution because they do work for each other. These interservice values must be recognized in a correct accounting scheme, yet many accountants have strenuously objected to this as a wheel-within-a-wheel distribution. It is true that each interservice charge modifies the cost of the recipient's output and that such charges go on until there seems to be no end to the performance. To get away from this dilemma, many accountants advise ignoring the interchanges in spite of the incorrectness of the suggestion. When interservice charges are made on a standard-cost basis, the objectionable difficulties disappear. This procedure is logically correct and will be justified in the opening paragraphs of Chap. VII.

To confine the attention to the distribution sheet (Fig. 6), the detailed derivation of service charges is withheld here and, instead, placed in Chap. VI. The entries are made by starting at the top of each service column (7 to 14) and charging at standard cost each department or account, including service departments, for all value received. In each of the columns (7 to 14) the distributed items are added up and the total is posted on the line, Standard Service Costs. After all of the service costs have been allocated on a standard basis, each service department's costs are added horizontally, columns 1 to 14, to ascertain the actual service cost for posting in column 15. The actual cost of running each service department thus obtained is again entered on the horizontal line, Actual Service Costs, in the appropriate column so that the difference between actual and standard conditions can be determined and reported on the Service Surplus or Service Deficit line.

Completing the Distribution Sheet.

All that is necessary to complete the distribution sheet is to enter the totals and prove the grand total. Departments which previously have not been added up horizontally are footed and entered in column 15. The Total Production, the General Overhead, the Added Facilities, and the net Service Surplus or Service Deficit are determined and entered in column 16. If there is a net service surplus it must be subtracted when column 16 is added to prove the grand total of the tabulation sheet. The actual service-department cost total is not entered in column

DEPARTMENTAL COST DISTRIBUTION SHEET — JANUARY 1927

			COST ELEMENTS						SERVICE DISTRIBUTIONS									
			DEPRECIATION 1	TAXES FIRE INSURANCE 2	EXPENSES 3	SUPPLIES 4	FUEL 5	PAY ROLL SALARIES 6	REAL ESTATE SERVICE 7	LABOR MAINTENANCE 8	TRANSPORTATION 9	MECHANICAL SERVICE 10	POWER STEAM 11	POWER ELECTRIC 12	TECHNICAL SERVICE 13	SUPERVISION 14	DEPART. COSTS 15	TOTALS 16
PRODUCTION	I-A	PRODUCTION DEPT. A	750.63	163.59		55.88	98.18	4378.90	287.50	197.05	50.60	64.90	785.00	422.16	90.00	232.79	7577.15	
	I-B	" " B	520.50	108.83		37.75		3111.10	287.50	140.00	53.10	22.00	456.00	375.79	189.00	166.29	5467.86	
	I-C	" " C	293.19	64.39		39.16		2873.55	112.50	129.31	56.50	99.00		98.84	168.75	99.77	4034.96	
	I-D	" " D	632.08	134.69		500.50		2238.81	337.50	100.74	64.25	52.80		183.56	245.25	166.29	4656.47	
		TOTAL PRODUCTION																21736.44
OVERHEAD	II	ADMINISTRATIVE	12.32	2.64	956.25			1380.00	15.00	5.85					22.50		2394.56	
	III	SALES	15.89	3.43	2025.61	75.42		1250.00	45.00		145.20				162.00		3722.55	
	IV	OFFICE	48.44	10.47	124.60	2.26		798.34	105.00	22.42		3.30					1114.83	
	V	WAREHOUSE	24.03	230.22		278.92		173.33	325.00	7.80	280.15	8.80		9.29	310.50		1648.04	
		GENERAL OVERHEAD																8879.98
ADDED FACILITIES	NC	NEW CONSTRUCTION									39.60	774.40			45.00		859.00	
	RB	RENEWAL OF BUILDINGS																
	RP	" " PLANT										203.50					203.50	
	SP	SPARE PARTS										71.50					71.50	
	MH	RAW MATERIAL HANDLING									155.60						155.60	
	FH	FUEL HANDLING									15.60						15.60	
	PFD	PATENTS FORMULAE DESIGN													400.50		400.50	
		ADDED FACILITIES																1705.70
SERVICE DEPARTMENTS	VI	REAL ESTATE DEPT.	780.67	627.63	333.52	8.75		225.34		10.14	23.40	19.80	141.00	19.75			2190.00	✓
	VII	LABOR MAINTENANCE DEPT.	57.37	12.24	368.72	9.03		151.67	150.00								749.03	
	VIII	TRANSPORTATION DEPT.	74.28	15.90		95.08		617.93	30.00	27.81		17.60					878.60	
	IX	MECHANICAL DEPT.	34.90	7.69	75.33	20.80		1012.20	65.00	45.55				57.56			1319.03	
	Xs	POWER STEAM	235.05	51.57	35.18	18.06	536.25	169.00	108.00	7.60	44.00	66.00		3.60	22.50		1296.81	
	XE	" ELECTRIC ETC.	345.78	74.09		515.46		141.00	27.00	6.35							1109.68	
	XI	TECHNICAL DEPT.	97.94	21.07	175.11	57.57		1120.34	120.00	20.42		13.20	15.00	12.25			1652.90	
	XII	SUPERVISION	19.30	4.05				621.33	15.00	5.46							665.14	
		STANDARD SERVICE COSTS							2030.00	726.50	928.00	1416.80	1397.00	1182.80	1656.00	665.14		
		ACTUAL " "						✓	2190.00	749.03	878.60	1319.03	1296.81	1109.68	1652.90	665.14		
		SERVICE SURPLUS									49.40	97.77	100.19	73.12	3.10			141.05
		" DEFICIT							160.00	22.53								
		COLUMN GROUP TOTALS	3942.37	1532.50	4094.32	1714.61	634.43	20262.84										32181.07

FIG. 6.—The complete departmental cost distribution sheet, January, 1927. Figure 5 showed the initial cost entries and Fig. 6 shows the final sheet after the allocation of the service department costs. The actual work is done on the form illustrated by Fig. 4, which, here, for the purposes of reproduction has been slightly modified and split into two parts.

16 because that would disturb the equilibrium of the distribution sheet by injecting this value into the final result a second time.

Theory of the Distribution Sheet.

Figure 7 gives an algebraic demonstration of the theory of the distribution sheet. On the diagram, X represents any entry. In the given location it is a charge against production and a credit to the general-ledger accounts assigned to column 6. A vertical addition of column 1 gives E_1 and this value must agree with the total of column group 1 on the tabulation sheet (Table VI). E_2, E_3, E_4, etc. are analagous quantities. If the original entry totals E_1, E_2, E_3, etc. are added horizontally, we arrive at the value T which must check the grand total of the tabulation sheet (Table VI).

To make the service distributions, every department is charged for all work done at the standard rate for the service under consideration. In column 7 the total charge, at standard cost, for all service performed is S_7. With similar vertical additions we obtain the values S_8, S_9, S_{10}, etc.

After all the service work has been accounted for at standard rates (including work done for other service departments), a horizontal addition will give the actual cost of running each service department. These total values A_7, A_8, A_9, etc. are again entered in appropriate columns on the horizontal line Actual Service Costs, as shown in Fig. 7.

When S_7 is smaller than A_7, the service deficit V_7 is entered on the lower line and it has a positive value. The reverse situation yields a surplus which has a negative value because it must be used to reduce an overstated cost. V_S is the sum of the surplus variations and V_D is the sum of the deficit variations. The net variation is given as V_T.

If we add horizontally all the charges in the production space, we get P_T, the cost of running the production departments.

In a similar manner we arrive at O_T and F_T. The individual department or account totals are entered in column 15. The sum of P_T, O_T, and F_T plus V_T as a deficit or minus V_T as a surplus must equal T, or the sheet is out of balance

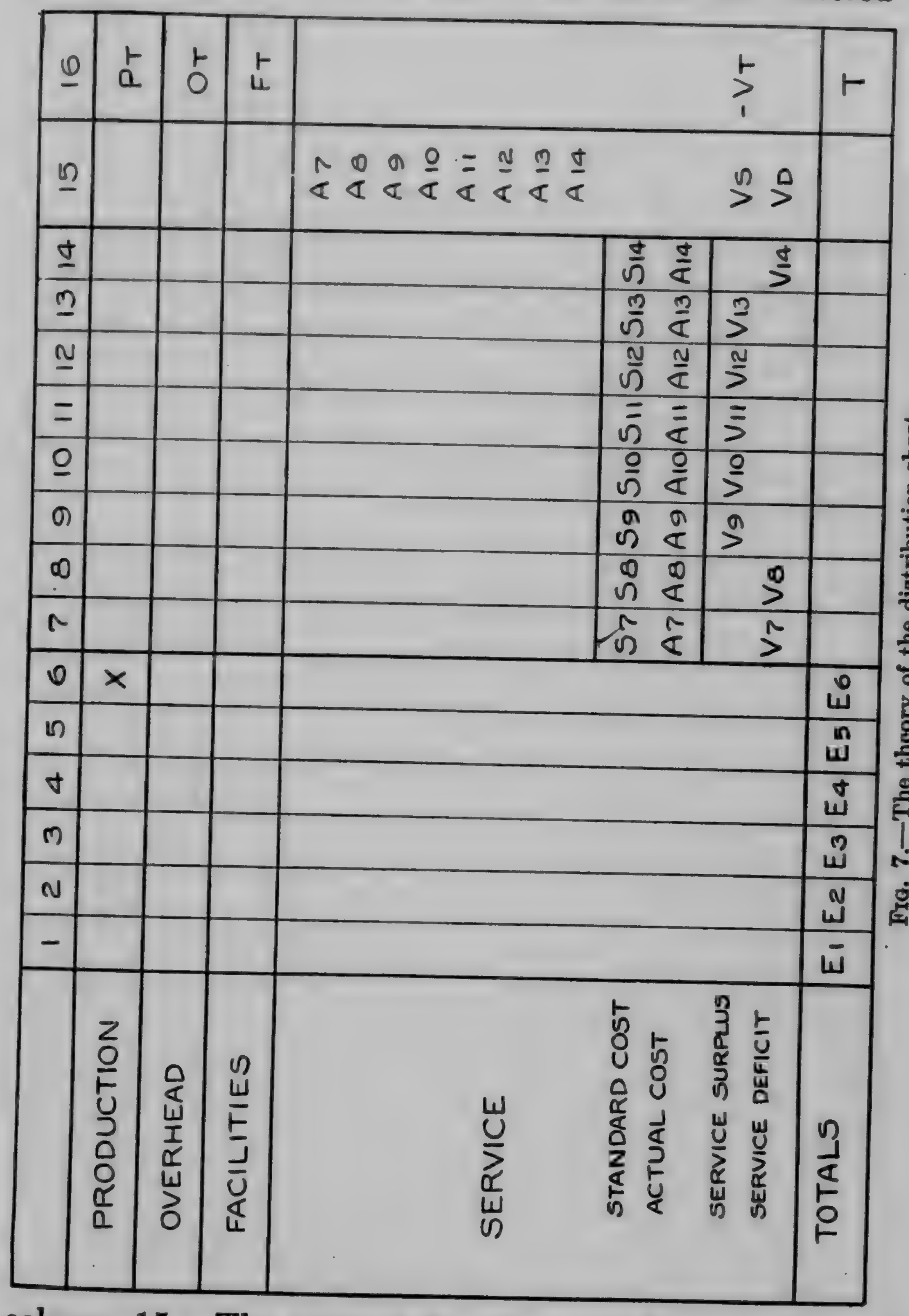

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
PRODUCTION
OVERHEAD
FACILITIES
SERVICE
STANDARD COST
ACTUAL COST
SERVICE SURPLUS
SERVICE DEFICIT
TOTALS
X
P_T
O_T
F_T
$-V_T$
T
A_7 A_8 A_9 A_{10} A_{11} A_{12} A_{13} A_{14}
V_S
V_D
S_7 S_8 S_9 S_{10} S_{11} S_{12} S_{13} S_{14}
A_7 A_8 A_9 A_{10} A_{11} A_{12} A_{13} A_{14}
V_9 V_{10} V_{11} V_{12} V_{13} V_{14}
V_7 V_8
E_1 E_2 E_3 E_4 E_5 E_6

FIG. 7.—The theory of the distribution sheet.

SYMBOLS

X represents an entry on the distribution sheet.
E represents an original-entry column total.
P represents the production total.
O represents the general-overhead total.
F represents the added-facility total.
A represents a service-department actual-cost total.
S represents a service-department standard-cost total.
V represents a service-department cost variation.
T represents the grand total.

FUNDAMENTAL EQUATIONS

(1) $\mathrm{E}_1 + E_2 + E_3 + E_4 + E_5 + E_6 = T$
(2) $P_T + O_T + F_T \pm V_T = T$
(3) $A_7 - S_7 = V_7$
(4) $V_D - V_S = V_T$

CHAPTER VI

RECORDING DEPARTMENTAL ACTIVITIES

Purpose of This Chapter.

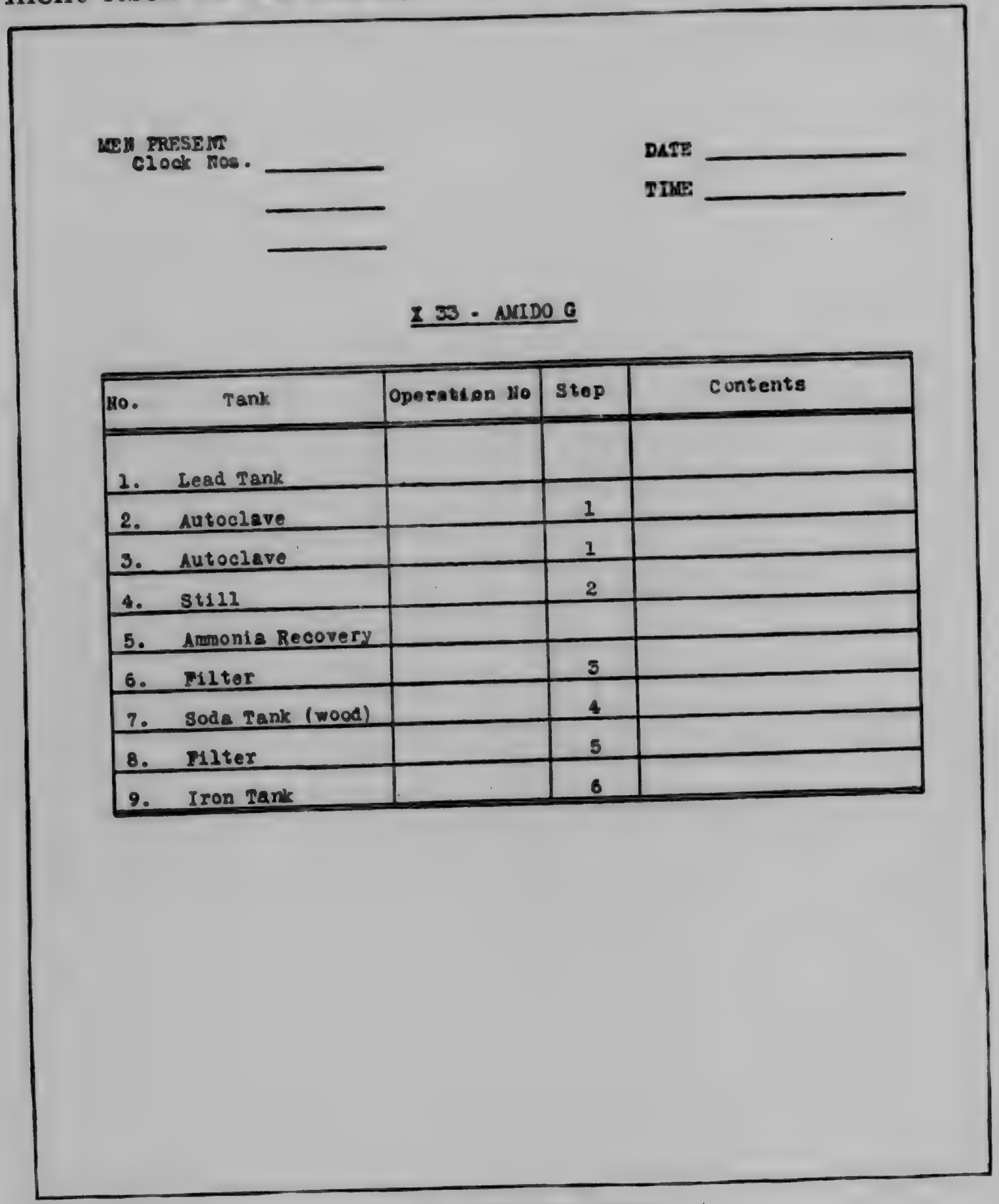
The purpose of this chapter is to develop methods for recording departmental activities. Although the art must be understood to make the actual cost distributions previously discussed, it has been withheld until this time to make possible a more effective presentation of the major parts of departmental cost allocation—with so many phases of accounting one is diverted only too easily into a side issue tributary to the main theme. This chapter will develop not only general facts about departmental activities but also the cost allocations used for the service departments in Chap. V.

The Need for Recording Departmental Activities.

There should be little question as to the need for a comprehensive system of records depicting the daily departmental activities of a business. To know each day the performance of every department in just as important as to know each day the goods shipped—from one we find out what departments to charge for internal services and from the other what customers to bill for goods. These records of departmental activities are the life blood of an informative cost system—without them the real facts can never be ascertained.

Production Departments.

In spite of the varying nature of specific manufactures, it is possible to make some general remarks on production reports. With the producing departments, even in their more rudimentary form, we get into a fairly elaborate system as there are progress, product, material, labor, machine, supply, power, etc., reports to be made daily. Whether the statistics are collected in detail by the department itself or are merely written on a blackboard for the office force to copy depends on the individual problem. The different purposes for which the facts are collected makes it difficult to embrace them all in one comprehensive document.



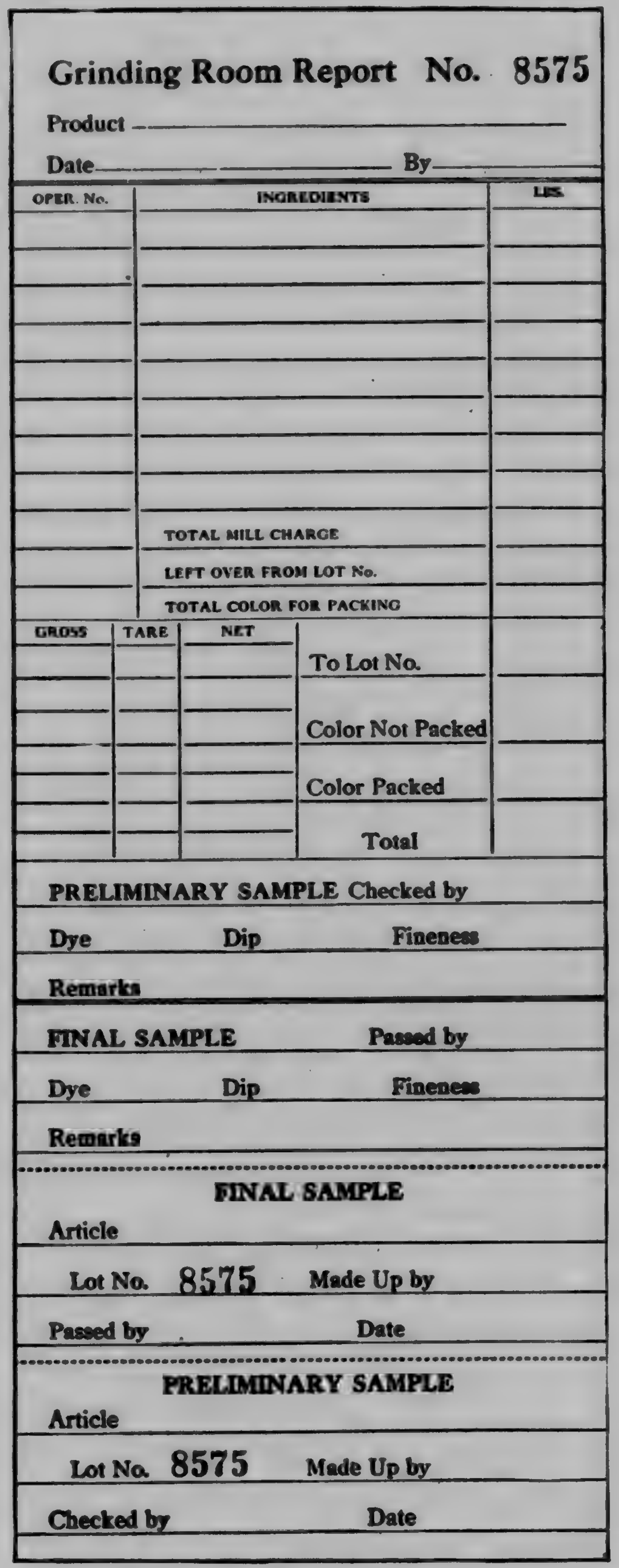
MEN PRESENT
Clock Nos. ________
____
____

DATE ________
TIME ________

X 33 - AMIDO G

No.	Tank	Operation No	Step	Contents
1.	Lead Tank			
2.	Autoclave		1	
3.	Autoclave		1	
4.	Still		2	
5.	Ammonia Recovery			
6.	Filter		3	
7.	Soda Tank (wood)		4	
8.	Filter		5	
9.	Iron Tank		6	

Fig. 8.—Progress report.



Grinding Room Report No. 8575
Product ________
Date ________ By ________

OPER. No.	INGREDIENTS	LBS.
	TOTAL MILL CHARGE	
	LEFT OVER FROM LOT No.	
	TOTAL COLOR FOR PACKING	

GROSS	TARE	NET		
			To Lot No.	
			Color Not Packed	
			Color Packed	
			Total	

PRELIMINARY SAMPLE Checked by
Dye Dip Fineness
Remarks

FINAL SAMPLE Passed by
Dye Dip Fineness
Remarks

FINAL SAMPLE
Article
Lot No. 8575 Made Up by
Passed by Date

PRELIMINARY SAMPLE
Article
Lot No. 8575 Made Up by
Checked by Date

Fig. 9.—Product report.

The object of the progress report is to show the management the manufacturing position of the various articles in process. In some industries a list of the equipment giving the number of the batch in each unit may suffice. With other types of production, a record of the output of each machine, together with the articles started and finished, is necessary. Some form of progress report is essential if manufacturing is to be planned and carried out according to schedule. Figure 8 illustrates a progress report which was typed and made up on one of the usual duplicating machines, because few copies were used during the year.

Of all the production records those dealing with articles usually are the first to be recognized in accounting. Such records covering a batch, a manufacturing order for a special number of articles, etc. are used to collect information as to time, materials consumed, and other data related to a particular lot of goods. A specimen card used for this purpose is illustrated in the text by Fig. 9. From the product reports we derive many facts for the calculation of article costs.

In some industries raw materials, in considerable amounts are carried on the production floor. By giving daily reports of the raw material put into process, it is possible to make the stock records reflect not only warehouse inventories but also the quantities of raw materials actually available for use.

The kind of daily-labor reports made depends entirely on the importance of this function. They vary from time-clock exactness to a simple charge for a man's entire time, and while considering the method to be used, it should not be overlooked that much expense and detail can be avoided by doing nothing further with the labor reports than comparing actual performance with standard. Care should be exercised to see that all the hours of labor are accounted for. Further information on this subject will be found on page 82.

Machine reports reveal the number of hours each unit is used each day. The same record at times may be instrumental in deciphering power, supply, and labor consumption. From a compilation of the number of hours a machine is used we are able to interpret the relation of output to equipment. This thought is further illustrated in the article on, Power: Electric, etc., by Fig. 16 on page 95.

General Overhead.

The administrative, office, and warehouse activities can more easily be handled by periodic audits than by daily analysis. As the costs are not chargeable to a particular product, such studies are made only on behalf of cheaper operating conditions. The warehouse department, when combined with the transportation department, must be checked by a system of daily reports—data on this will be presented later. The sales department is usually analysed by the report method; for facts on this the reader is referred to the many excellent books on selling such as "Market Analysis" by Percival White, published by the McGraw-Hill Book Company, Inc., New York. ADV.

Real-estate Department.

By injecting a real-estate department, even though it is non-existent as a separate function, we bring an essential cost to a natural focus and avoid the confusion arising through a premature dispersion of these values to other departments. When a company operates on rented property, the determination of real-estate service costs becomes a simple matter. When, however, a company operates on its own property, a system of cost records must be set up to show the average cost of real-estate service over a long period of years.

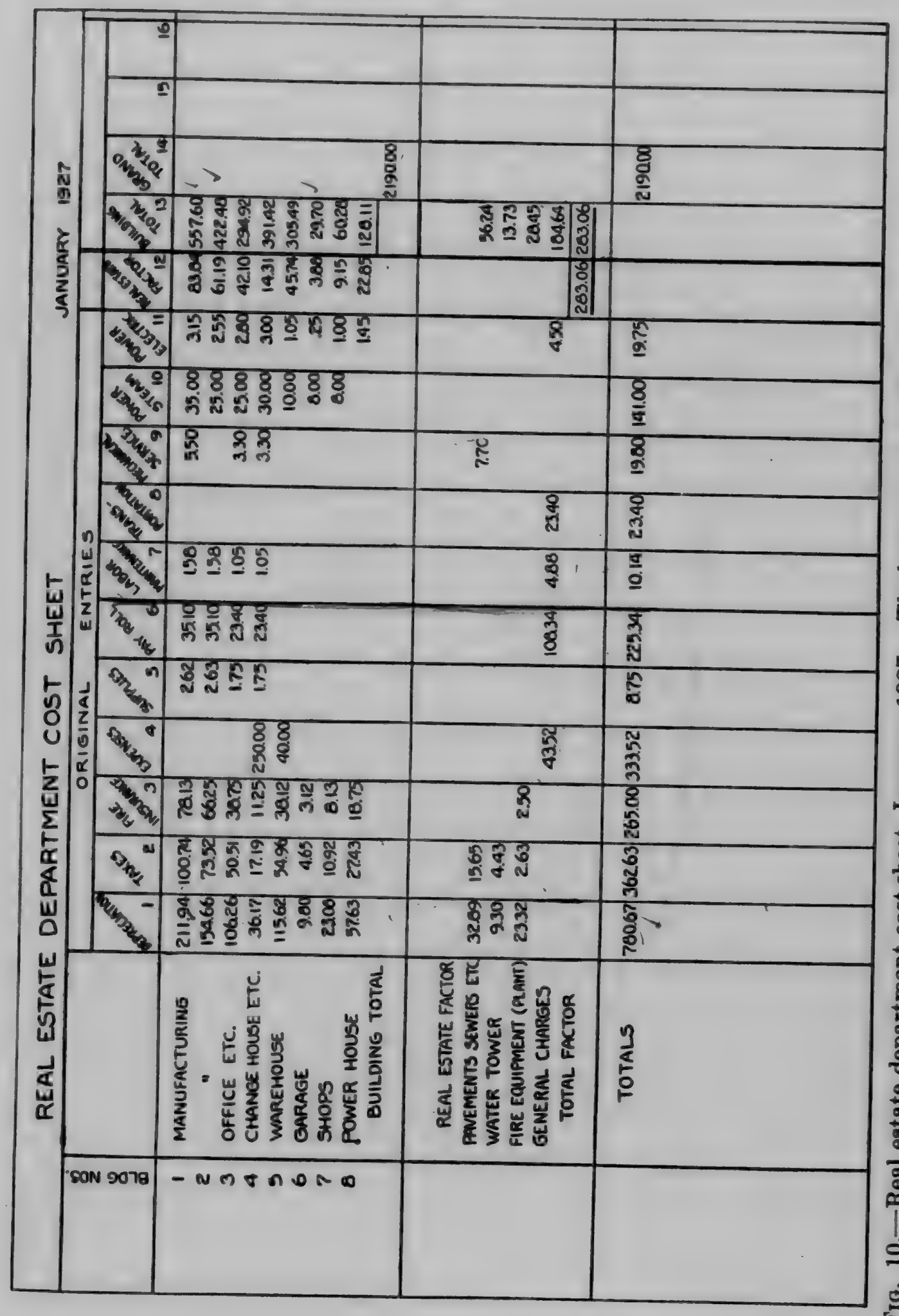
The derivation of the individual building costs for January, 1927, is shown on the Real Estate Department cost sheet (Fig. 10). Table XIII gives the essential data for calculating the depreciation, taxes and fire-insurance entries in columns 1, 2, and 3. The last items of depreciation, $23.32; taxes $2.63; and fire insurance, $2.50 all come from previous calculations for plant values charged to the Real Estate Department. Under Expenses, column 4, $250 is the cost of painting the interior of the change house and lunchroom, $40 is the premium on elevator liability for 1927, and $43.52 is the cost of 1927 public liability insurance.

Table XIII.—Detailed Building and Structure Account

	First cost	Insurable value
Building 1: Manufacturing	$ 50,865.31	$ 62,500.00
Building 2: Manufacturing	37,119.63	53,000.00
Building 3: Administrative, office, sales, technical, etc.	25,502.85	31,000.00
Building 4: Change house, lunchroom	8,680.20	9,000.00
Building 5: Warehouse	27,750.00	30,500.00
Building 6: Garage	2,350.00	2,500.00
Building 7: Shops	5,540.00	6,500.00
Building 8: Power house	13,832.07	15,000.00
Pavements, sewers, etc.	7,893.33	
Water tower	2,232.70	
Total	$181,766.09	$210,000.00

Depreciation rate 5 per cent per annum.
Tax rate, $3.60 per $100 assessed valuation $120,000.
Insurance rate, $1.50 per $100 insurable value.

The first four items of payroll allocate the janitor's wages, in column 5 the supplies he used, and in column 7 the corresponding labor maintenance charges at the standard rate of 4½ per cent of the payroll (see p. 82). The $108.34 entry in column 6 is the night watchman's wage—the $4.88 of column 7 being the standard 4½ per cent labor maintenance surcharge. The transportation charge was for 36 hours of yard cleaning at the standard rate of 65 cents and hour (see p. 87). The mechanical service charges are all for work done at the standard rate of $1.10 an hour (see p. 88). The steam-heating items have been obtained by calculating the probable consumption and charging for it at the standard rate of $1 per 1,000 pounds of



REAL ESTATE DEPARTMENT COST SHEET JANUARY 1927

BLDG NOS.		ORIGINAL ENTRIES															
		Depreciation 1	Taxes 2	Fire Insurance 3	Expenses 4	Supplies 5	Pay Roll 6	Labor Maintenance 7	Transportation 8	Mechanical Service 9	Power Steam 10	Power Electric 11	Real Estate Factor 12	Building Total 13	Grand Total 14	15	16
1	MANUFACTURING	211.94	100.74	78.13		2.62	35.10	1.58		5.50	35.00	3.15	83.84	557.60	✓		
2	"	154.66	73.52	66.25		2.63	35.10	1.58			25.00	2.55	61.19	422.48	✓		
3	OFFICE ETC.	106.26	50.51	38.75		1.75	23.40	1.05		3.30	25.00	2.80	42.10	294.92			
4	CHANGE HOUSE ETC.	36.17	17.19	11.25	250.00	1.75	23.40	1.05		3.30	30.00	3.00	14.31	391.42			
5	WAREHOUSE	115.62	54.96	38.12	40.00						10.00	1.05	45.74	305.49			
6	GARAGE	9.80	4.65	3.12							8.00	.25	3.88	29.70	✓		
7	SHOPS	23.06	10.92	8.13							8.00	1.00	9.15	60.28			
8	POWER HOUSE	57.63	27.43	18.75								1.45	22.85	128.11			
	BUILDING TOTAL														2190.00		
	REAL ESTATE FACTOR																
	PAVEMENTS SEWERS ETC	32.89	15.65							7.70				56.24			
	WATER TOWER	9.30	4.43											13.73			
	FIRE EQUIPMENT (PLANT)	23.32	2.63	2.50										28.45			
	GENERAL CHARGES				43.52		108.34	4.88	23.40			4.50		184.64			
	TOTAL FACTOR												283.06	283.06			
	TOTALS	780.67 ✓	362.63	265.00	333.52	8.75	225.34	10.14	23.40	19.80	141.00	19.75			2190.00		

Fig. 10.—Real estate department cost sheet, January, 1927. The lower totals on Fig. 10 agree with the values on the horizontal line, VI Real Estate Department, shown on Fig. 6. The form of Fig. 4, is used for these calculations.

steam (see p. 91). The lighting costs are established by considering the size of the lamps and the probable number of hours per month they are burned and extending these amounts at the standard rate of 10 cents per kilowatt-hour.

As the real estate charges are distributed on a standard-cost basis, Fig. 10 need not be made up until the major distribution sheet (Fig. 6) has been posted. The initial entries on the Real Estate Department cost sheet must agree with the values on the parent record. The total real-estate factor is allocated on an area basis or in accordance with first-cost building values as in the problem, either method being a convenient way of disposing of such general charges as yard cleaning, night watchman, miscellaneous structures maintenance, etc. The accounting principles of the Real Estate Department cost sheet are identical with those of the major distribution sheet (Fig. 6).

Table XIV.—Comparison of Actual Costs and Standard Charges for Buildings

	January, 1927, costs	Standard charges	Surplus	Deficit
Building 1	$ 557.60	$ 575.00	$17.40	
Building 2	422.48	450.00	27.52	
Building 3	294.92	300.00	5.08	
Building 4	391.42	150.00	......	$241.42
Building 5	305.49	325.00	19.51	
Building 6	29.70	30.00	.30	
Building 7	60.28	65.00	4.72	
Building 8	128.11	135.00	6.89	
Total	$2,190.00	$2,030.00	$81.42	$241.42
Net	....	....	......	$160.00

Table XIV compares the actual building costs for January, 1927, with the standard charges. The surplus and deficit figures are meaningless until they have been added to the net variation accrued from previous years. Table XV shows the distribution of standard building charges used on Fig. 6, the Departmental Cost Distribution Sheet.

Table XV.—Distribution of Standard Real-estate Costs to Departments

Building 1	$ 575.00	
50 Per Cent Production Department A		$ 287.50
50 Per Cent Production Department B		287.50
Building 2	450.00	
25 Per Cent Production Department C		112.50
75 Per Cent Production Departnent D		337.50
Building 3	300.00	
5 Per Cent Administrative		15.00
15 Per Cent Sales		45.00
35 Per Cent Office		105.00
40 Per Cent Technical		120.00
5 Per Cent Supervision		15.00
Building 4	150.00	
100 Per Cent Labor Maintenance		150.00
Building 5	325.00	
100 Per Cent Warehouse		325.00
Building 6	30.00	
100 Per Cent Transportation		30.00
Building 7	65.00	
100 Per Cent Mechanical Service		65.00
Building 8	135.00	
80 Per Cent Steam		108.00
20 Per Cent Electric		27.00
Total Real Estate	$2,030.00	$2,030.00

Labor-maintenance Department.

Labor maintenance in a business may be so scattered that instead of being a separate function it exists only in the books of account. In the example, one man's entire time is given to the various labor-maintenance activities. The items on Fig. 6 which make up his department's expenses are $57.37 for depreciation of change house and lunchroom equipment, etc., $12.24 taxes and fire insurance on the same item, $42.80 payroll insurance for the year, $325.92 employees' liability insurance for the month, $9.03 supplies by requisition, $151.67 wages, and $150 real-estate service. The total Labor Maintenance Department cost for January is $749.03.

The allocation of this cost is made in direct proportion to the dollar of payroll. Although the number of men employed and the hours of labor activity have a modifying influence on the distribution, the results of such a refinement hardly warrant abandoning the more convenient figure. By using the standard labor-maintenance rate of 4½ per cent of each item of payroll, we get the values entered in column 8 on the distribution sheet of Chap. V.

The records kept by the Labor Maintenance Department are of three general interdependent types. First, there are the historical records giving the story of each employee. Second, there are the payrolls showing who received money and how much. Finally, there are the various time-distribution records. Several phases of labor accounting more properly related to other departments of the business are presented in unified form at this point.

Labor accounting occurs in its simplest state when we can assign to each man a time-clock number corresponding to the department in which he works. Each division then makes a daily report in classified form, showing what was done with the labor hours bought. This simple case, however, rarely occurs in practice. It is often necessary to transfer men from one department to another. Appropriate slips verifying these changes must be submitted to the payroll clerk so that he can adjust his records. Further, complications arise because wage payments usually are made on a weekly basis, whereas the general accounting period is a month.

When labor is bought on an hourly basis, six records are required if all the cost data are to be registered.

1. A time card to show the hours supplied by every man each day.
2. A payroll book to record the net weekly wage payments.
3. A labor-distribution book to show the number of hours and the total cost of the labor supplied to each department.

4. Labor transfer slips to record the shifting of men to other departments.
5. A daily report from each department to get the number of hours spent on each classified job.
6. A monthly record sheet such as Fig. 12 to be used for assembling the daily statistics gathered from each department.

It is almost needless to say that these six records must check each other at all related points. An interesting Chapter, Time and Pay, is to be found in A. H. Church's "Manufacturing Costs and Accounts," published by McGraw-Hill Book Company, Inc., New York.

Piece-rate accounting must proceed along lines which admit no controversies with the men. One of the simplest, yet most effective methods is to supply each man with a pass book much like the one used in a bank. After a man has finished his task and the work has been verified he can go to a convenient central location and receive credit for his work in the pass book. At the end of the week his wages can be quickly figured from the credits in his book. Men follow their wages closely so if common talley is kept, the danger of a lost accounting slip stirring up a controversy is avoided.

Many incentive plans for stimulating workers have been suggested. The numerous uncertainties attending the chemical manufactures make it difficult to establish satisfactory premium systems. Whatever is tried should be thoroughly investigated beforehand. Those interested in this subject will find much material of value in the "Management Handbook" published by The Ronald Press Company of New York.

With respect to many of the modern recording devices, it is to be noted that a good old-fashioned, but not obsolete time book will often give results well within the desired limits of accuracy. The small working force engaged in a large area together with the severe factory conditions make instruments costly to install and costly to maintain. In some situations there is much to be said in favor of these devices.

Transportation Department.

The daily use of both men and trucks must be recorded to get a complete picture of the activities of the transportation department. Figure 11 shows a convenient form for collecting daily statistics for posting to the Monthly Record Sheet (Fig. 12). Figure 13 shows how the entries are made. The labor hours are extended at the standard rate of 65 cents an hour and the truck charges at $1 an hour. A comparison of actual costs with the standard rates is given in Table XVI. Truck and labor costs are added together, as in Table XVII, to get the entries for column 9 on the distribution sheet (Fig. 6).

TABLE XVI.—TRANSPORTATION DEPARTMENT COST COMPARISONS[1]

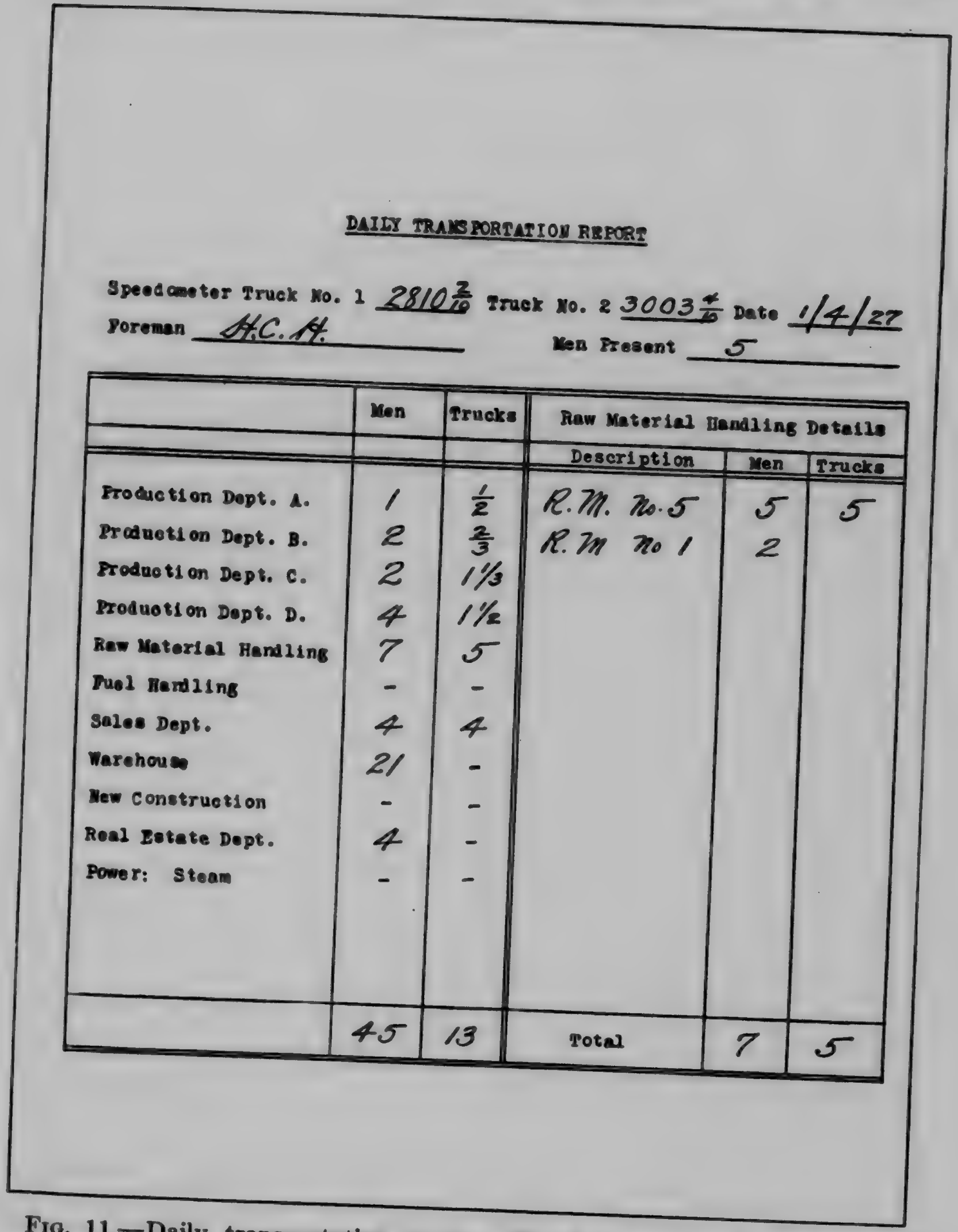
Trucks:		
Depreciation	$ 74.28	
Taxes and Insurance	15.90	
Supplies	95.08	
Real Estate Service	30.00	
Mechanical Service	17.60	
Total	$232.86	
Trucks used 252 hours at $1 per hour	252.00	
Surplus		19.14
Labor:		
Payroll	$617.93	
Labor Maintenance	27.81	
Total	$645.74	
1,040 hours at 65 cents	$676.00	
Surplus		$30.26
Net Surplus for Transportation Department		$49.40

---

[1] These costs are obtained from the horizontal line, Transportation Department, Fig. 6 and from Fig. 13.

In the problem it has been assumed that the transportation service rendered to individual production departments can be determined separately. Where material delivery and collection hours only can be established as a total for

all departments, a distribution based on actual weights modified by a minimum package charge will be necessary.



DAILY TRANSPORTATION REPORT

Speedometer Truck No. 1 $2810\frac{2}{10}$ Truck No. 2 $3003\frac{4}{10}$ Date 1/4/27

Foreman H.C.H. Men Present 5

	Men	Trucks	Raw Material Handling Details		
			Description	Men	Trucks
Production Dept. A.	1	$\frac{1}{2}$	R.M. No. 5	5	5
Production Dept. B.	2	$\frac{2}{3}$	R.M No 1	2	
Production Dept. C.	2	$1\frac{1}{3}$			
Production Dept. D.	4	$1\frac{1}{2}$			
Raw Material Handling	7	5			
Fuel Handling	-	-			
Sales Dept.	4	4			
Warehouse	21	-			
New Construction	-	-			
Real Estate Dept.	4	-			
Power: Steam	-	-			
	45	13	Total	7	5

FIG. 11.—Daily transportation report. The data collected daily by this report are tabulated on the form shown in Fig. 12. Column 4 of Fig. 13 shows how this is done.

As a matter of fact, it is wise to fix such costs whenever the gross value of the transportation service warrants the calculation. In the problem the charge against the sales department is for goods delivered to the freight station or to customers. The warehouse entry covers the time spent in getting finished stock ready to ship. The new construction

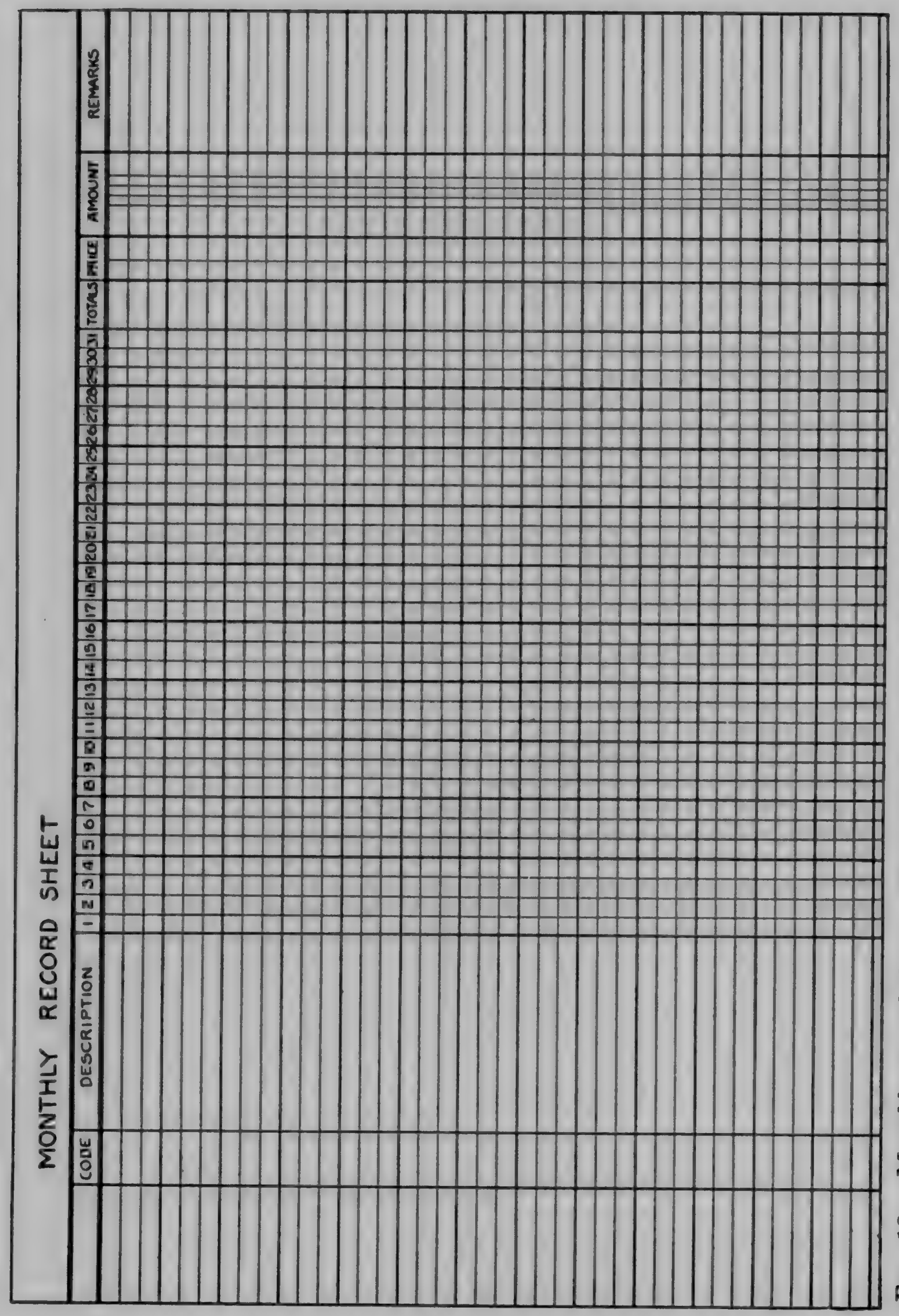
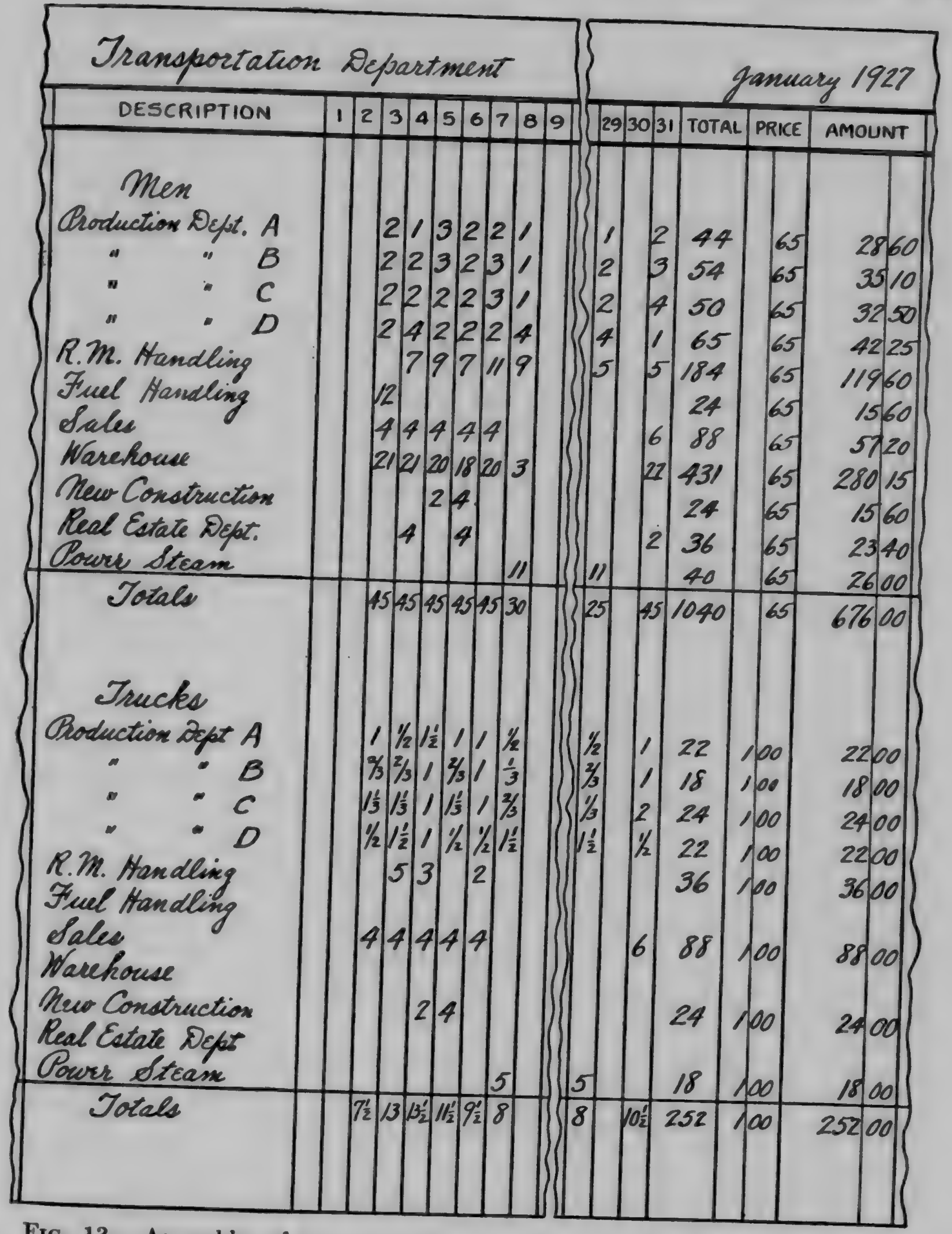

MONTHLY RECORD SHEET
CODE
DESCRIPTION
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
TOTALS
PRICE
AMOUNT
REMARKS

FIG. 12.—Monthly record sheet. This form is used by the transportation department and other units for the compilation of monthly statistics. Figure 13 shows how the form is used.

item is for material picked up by truck. The Real Estate Department was charged $23.40 for snow shoveled during the month and it cost $44 to remove ashes from the power house during January.



Transportation Department

January 1927

DESCRIPTION	1	2	3	4	5	6	7	8	9	29	30	31	TOTAL	PRICE	AMOUNT
Men															
Production Dept. A			2	1	3	2	2	1		1		2	44	65	28 60
" " B			2	2	3	2	3	1		2		3	54	65	35 10
" " C			2	2	2	2	3	1		2		4	50	65	32 50
" " D			2	4	2	2	2	4		4		1	65	65	42 25
R.M. Handling				7	9	7	11	9		5		5	184	65	119 60
Fuel Handling			12										24	65	15 60
Sales			4	4	4	4	4					6	88	65	57 20
Warehouse			21	21	20	18	20	3				22	431	65	280 15
New Construction					2	4							24	65	15 60
Real Estate Dept.				4		4						2	36	65	23 40
Power Steam								11		11			40	65	26 00
Totals			45	45	45	45	45	30		25		45	1040	65	676 00
Trucks															
Production Dept A			1	½	1½	1	1	½		½		1	22	1 00	22 00
" " B			⅔	⅔	1	⅔	1	⅓		⅔		1	18	1 00	18 00
" " C			1⅓	1⅓	1	1⅓	1	⅔		⅓		2	24	1 00	24 00
" " D			½	1½	1	½	½	1½		1½		½	22	1 00	22 00
R.M. Handling				5	3		2						36	1 00	36 00
Fuel Handling															
Sales			4	4	4	4	4					6	88	1 00	88 00
Warehouse															
New Construction					2	4							24	1 00	24 00
Real Estate Dept															
Power Steam								5		5			18	1 00	18 00
Totals			7½	13	13½	11½	9½	8		8		10½	252	1 00	252 00

FIG. 13.—Assembly of transportation department charges, January, 1927. A portion of Fig. 12 is illustrated here. The values in column 4 come from Fig. 11. The totals are used later in Table XVII.

TABLE XVII.—DISTRIBUTION OF TRANSPORTATION COSTS TO DEPARTMENTS[1]

Department	Hours		Amount		
	Truck	Men	Truck	Men	Total
Production Department A	22	44	$ 22.00	$ 28.60	$ 50.60
Production Department B	18	54	18.00	35.10	53.10
Production Department C	24	50	24.00	32.50	56.50
Production Department D	22	65	22.00	42.25	64.25
Sales	88	88	88.00	57.20	145.20
Warehouse	...	431	....	280.15	280.15
New construction	24	24	24.00	15.60	39.60
Material handling	36	184	36.00	119.60	155.60
Fuel handling	...	24	....	15.60	15.60
Real estate	...	36	....	23.40	23.40
Steam	18	40	18.00	26.00	44.00
Total	252	1,040	$252.00	$676.00	$928.00

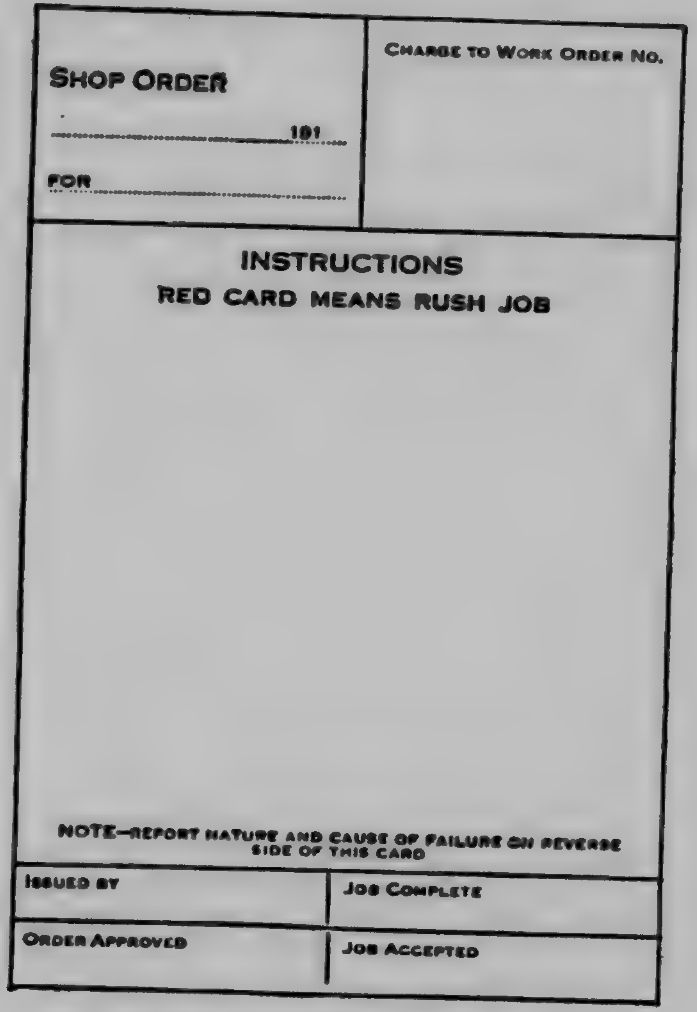
[1] These values are obtained from Fig. 13. The truck- and labor-cost totals are entered in column 9, Fig. 6.

The cost of unloading and storing specific raw materials must be secured and only can be secured if an itemized record is kept as on Fig. 11. Each day the raw-material details must agree with the total hours on the left-hand side of the sheet. At the end of the month this data is recapitulated to get the unloading costs for separate raw materials. For January the handling cost of Raw Material No. 1 amounted to 18 hours labor at 65 cents an hour or $11.70. This item appears on Fig. 27, page 135.

Mechanical Department.

Recording the activities of the mechanical department presents a problem identical to that of the transportation department. Whether or not separate labor and machine rates are developed depends entirely on the scope of the mechanical department. In the example, a compound rate for men and shops is used because the shops are not highly organized and exist as a convenient auxiliary to regular hand labor. The standard mechanical service cost used here is $1.10 per hour. The use of separate labor and machine rates was developed in the discussion on the transportation department.

A good deal has been written about not permitting any maintenance work to be done without a written order. This is a good thought for when the focus of the mechanical department is remote from those who worry about getting money to meet the payrolls, a lot of unnecessary jobs are apt to become normal activities. So as not to tie up the department with a lot of red tape, standing orders have been suggested for minor work. When the jobs are carefully planned this method is good; but when the department must be casually directed by the general superintendent, the scheme does not work out quite so well, because the exact nature of the work covered by each standing order is not always apparent. If open orders are not used, it may be desirable at times to have the work done before the order



SHOP ORDER

......................................191....

FOR..

CHARGE TO WORK ORDER NO.

INSTRUCTIONS

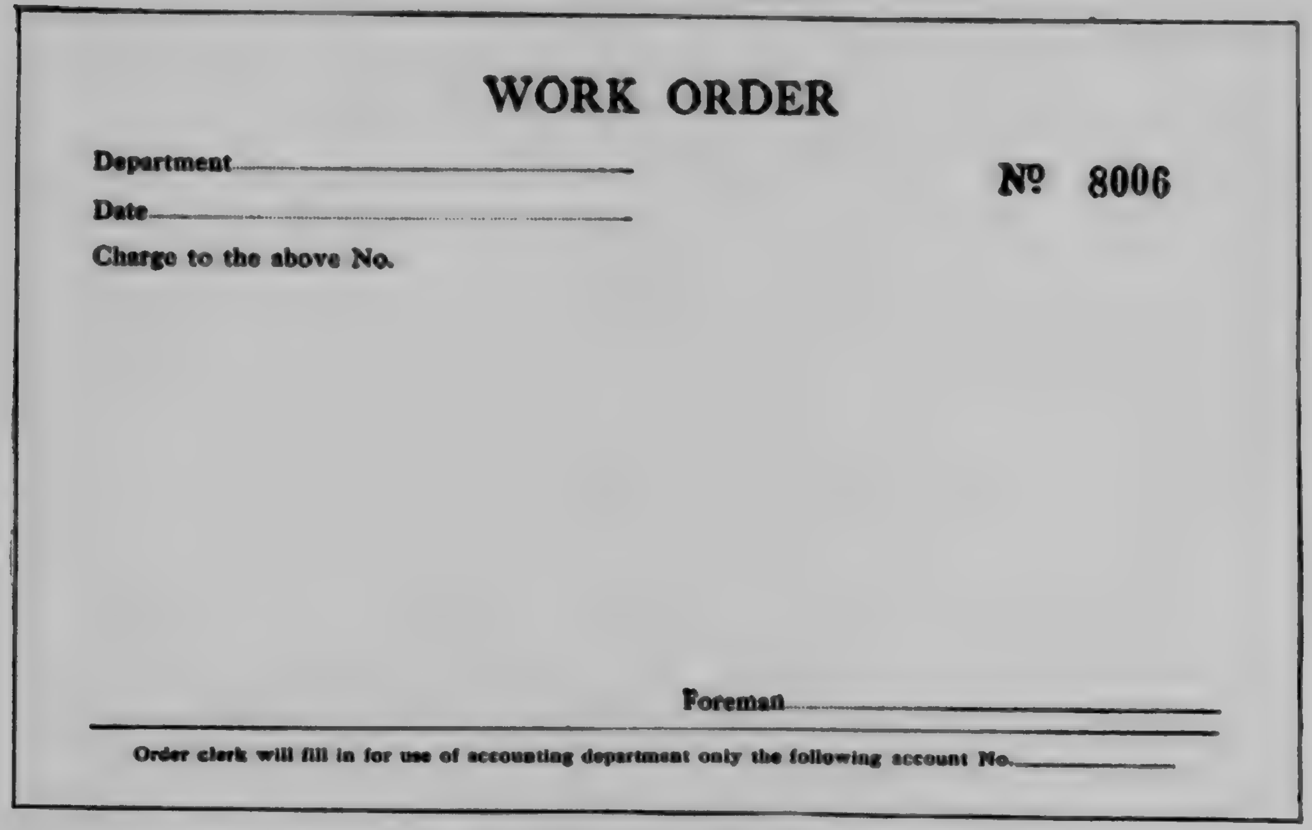
RED CARD MEANS RUSH JOB

NOTE—REPORT NATURE AND CAUSE OF FAILURE ON REVERSE SIDE OF THIS CARD

ISSUED BY	JOB COMPLETE
ORDER APPROVED	JOB ACCEPTED

FIG. 14.—Shop order.

is written out. A daily review of the work-order file will post the superintendent on mechanical activities. Figures 14 and 15 illustrate two types of mechanical work orders—serially numbered ones are preferable. Costing each order is not advisable as it adds extensively to the burden of accounting without adding greatly to the control which can be had by religiously inspecting the orders.



WORK ORDER

Department__________ № 8006

Date__________

Charge to the above No.

Foreman__________

Order clerk will fill in for use of accounting department only the following account No.__________

FIG. 15.—Work order.

Power—Steam.

In the smaller plants, very often, the consumption and production of steam can only be estimated within wide limits. The various meters and coal-weighing devices add too great a burden of fixed investment to the small factory; yet in spite of these limitations it is possible, by using pencil, paper, engineering handbooks, ordinary pressure gauges, and barrels to catch condensed water, to get a rough idea of detailed steam costs. Where exhaust steam is used in processes, the problem becomes one of properly interpreting joint costs. After the steam consumption per process has been fixed by meter, calculation, or a mere guess, the cost allocation is not difficult. A monthly record of production multiplied by the standard units of steam consumption per process will give a total for comparison with the feed water meter readings or with the estimated steam production based on the pounds of coal burned. By juggling these two values, a steam distribution can be obtained which, even though it be but a random guess, is more accurate than those impossible labor-hour allocations of steam consumption.

Some interesting information on steam will be found in "A Cost System for Steam Power Plants" by P. S. Austen, published in *Manufacturing Industries*, January, 1927, and in "Management of Industrial Power," published in *Mechanical Engineering*, August, 1927. This last article is in two parts. H. F. Scott gives the engineer's point of view and W. N. Polakov gives the executive's point of view.

A DV.

TABLE XVIII.—POWER: STEAM-COST DISTRIBUTION[1]

Department	Calculated consumption	Adjusting factor	Actual consumption	Standard rate per 1,000 lbs. steam	Cost
Production Department A...........	628,000	1.25	785,000	1.00	$ 785.00
Production Department B...........	364,800	1.25	456,000	1.00	456.00
Real-estate service....	112,800	1.25	141,000	1.00	141.00
Technical...........	12,000	1.25	15,000	1.00	15.00
	1,117,600	....	1,397,000	....	1,397.00
Actual cost..........	....	....	....	....	1,296.81
Surplus variation.....	....	....	....	....	$ 100.19

[1] These values are used in column 11, Fig. 6.

On the Departmental Cost Distribution Sheet, (Fig. 6, p. 68), the steam costs for January are given as depreciation on boilers, steam lines, coal elevator, etc., $235.05; taxes and insurance thereon, $51.57; boiler insurance for 1927, $35.18; supplies, $18.06; coal used (90 tons at $5.95 per ton plus cost variation of 75 cents), $536.25; fireman's wages $169; building charge, $108.00; labor maintenance, $7.60; ash removal by the transportation department $44; supervision by master mechanic and repairs, $66.00; electricity to run coal elevator, $3.60; and tests by the technical department, $22.50. These charges, totaling $1,296.81, divided by the feed-water meter reading of 1,397,000 pounds gives an actual cost of $0.928 plus per 1,000 pounds of steam delivered at the machines. Table XVIII shows the complete distribution of steam costs at the standard rate of $1 per 1,000 pounds with the adjustment of calculated consumption to actual conditions.

Power—Electric, etc.

The allocation of electric-power costs leads to many minor calculations, for when we analyse the situation, we find ourselves concerned not only with an apportionment between electric lights, furnaces, motors, and other appliances, but also with further distributions which continue until we arrive at definite charges to specific departments and processes. Unless a cost distribution of electric power recognizes each final application, it teaches us nothing. To get into this vast detail may seem an unnecessary burden, yet after the pioneer stage has been passed the task possesses no great complexities and, besides, much light is shed on the intricacies of the industrial structure—this phase alone is worth the effort. The complete electric power problem presents itself as:

A. Calculating the cost of electric power delivered at the consuming machine.

B. Distributing electric current costs to:

1. Motors.
2. Lights.
3. Furnaces, electrolytic cells or other appliances.

C. Determining the cost of operating each motor.

D. Determining the cost of each class of service produced, such as:

1. Mechanical power delivered by shafting.
2. Compressed air.
3. Vacuum.
4. Refrigeration.
5. Water.
6. Gas.

E. Distributing the cost of the services obtained under *D* to the various departments benefited.

F. Summing up the cost of the electric and sundry power services received by each department to get the charges for use on Fig. 6, page 69.

The ramifications of the electric-power problem are revealed by the outline just given. One might readily ask why such heterogeneous things are brought together for a common distribution. The answer to this is that often the services are related not only through the motivating power, electricity, but also are bound together by having a single department responsible for their production. Further, as a correct accounting is difficult to get for each class of service, we confine our errors within the natural boundaries set by the total cost.

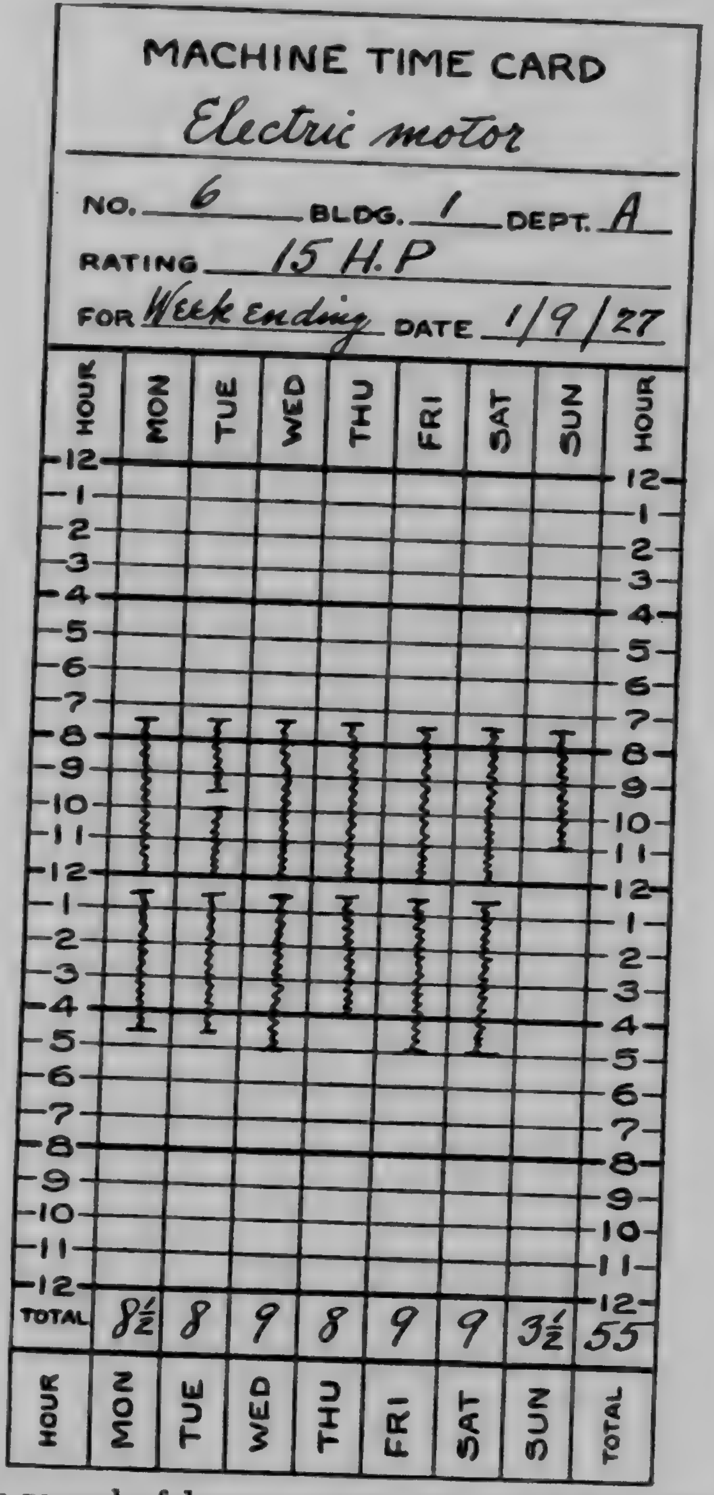
Although the initial investigation of the electric and sundry power problem should be of a most searching character the routine distributions can be based on assumptions which do not exactly depict the facts, but give convenient approximations of them. Many of these services will be found, on examination, to exist in such small volumes that the sensible thing to do is to group them for an arbitrary distribution on an estimated percentage basis. A good method, however, is not easily devised without making a thorough study of the size of the components.

In the problem solved in this book, four services—lighting, motors, shafting, and compressed air—have been selected to illustrate the distributions. As practically the entire electric current is used to run motors, the lighting component has been charged in at purchased cost rather than at delivered cost. The cost of operating electric motors includes not only the charges for maintaining the replacement units which are so essential under the severe conditions of a chemical plant, but also the entire cost of transmitting electric current over the wires within the factory limits. Motor operating costs are distributed at standard cost in direct proportion to the horsepower-hours consumed by each active unit without trying to penalize particular locations for any unusual events.

Shafting has been used to designate pulleys, belts, and all accessories, even though a proper solution demands a separate accounting for belts. As the motor allocations thoroughly illustrate the problem, which only involves changing the distribution units to square feet of single ply belt used, it was thought unnecessary to add such a calculation to the text. Further remarks on this subject will be found in Chap. XVII.

Compressed air has been selected to represent vacuum and other kindred services which, at times, must be distributed according to approximate estimates of the quantities actually used. With these qualifying remarks we will pass on into what is probably the most involved phase of chemical factory accounting.

Calculating the cost of electric current delivered at the consuming machine may entail the derivation of powerhouse generating costs or it may deal only with the increment of expense arising through the transmission of purchased electricity over factory wires. Table XIX shows the primary allocation of bought power and associated charges. The 20,130 kilowatt-hours purchased are apportioned at cost between the lights and motors. The other entries on the table are for depreciation, taxes, fire insurance, labor, supplies, etc., as determined by reports, requisitions, and calculations for the four items, lighting, motors, general shafting, and compressed air. Adding horizontally gives the net lighting cost of $19.01 (74 cents less than the actual charge to the Real Estate Department), the motor operating cost of $781.16, and the shafting and compressed-air charges, exclusive of motor costs, amounting to $223.93 and $85.98, respectively. Table XIX merely apportions the values previously obtained on Fig. 6 among these four items. This is the first stage in the derivation of the charges for column 12, Fig. 6.



MACHINE TIME CARD

Electric motor

NO. 6 BLDG. 1 DEPT. A

RATING 15 H.P

FOR Week ending DATE 1/9/27

HOUR	MON	TUE	WED	THU	FRI	SAT	SUN	TOTAL
TOTAL	8½	8	9	8	9	9	3½	55

Fig. 16.—Weekly record of hours motors are operated. This card is useful in recording the approximate operating time of many different kinds of machines.

The next step is the determination of the cost of running each motor. As it is impossible to meter them all continuously, a weekly card like Fig. 16 must be used to record the number of hours each motor is run during the month. In the absence of exact knowledge of the load

TABLE XIX.—PRIMARY DISTRIBUTION OF ELECTRIC POWER COSTS[1]

	Depreciation	Taxes and insurance	Supplies	Electricity	Payroll	R. E.	Labor service	Totals
Lighting	......	......	$ 2.30	$ 4.95	$ 11.25	......	$ .51	$ 19.01
✓ Motors	$201.70	$43.18	2.95	498.40	26.25	7.50	1.18	781.16
✓ Shafting	108.20	23.23	5.06	....	76.50	7.50	3.44	223.93
Air compressors	35.88	7.68	1.80	....	27.00	12.00	1.22	85.58
Totals	$345.78	$74.09	$12.11	$503.35	$141.00	$27.00	$6.35	$1,109.68

[1] The lower totals must agree with the corresponding figures on the horisontal line X_E Power—Electric, etc., on Fig. 6.

on each, horsepower ratings are used to the result that 37,935 horsepower-hours are accounted for in Table XX, whereas, only 26,710 were supplied. The cost extensions can be made on an actual cost basis or at a standard rate like the $0.0225 per horsepower-hour used in the problem.

TABLE XX.—INDIVIDUAL MOTOR-COST CALCULATIONS[1]

No.	Horsepower		Hours	Horsepower-hours	Standard cost	Motor
1	35	Air compressor	150	5,250	$0.0225	$118.12
2	10	Coal elevator	16	160	....	3.60
3	7½	Warehouse elevator	55	413	....	9.29
4	½	Technical Department	184	92	....	2.07
5	10	Mechanical Department	120	1,200	....	27.00
6	15	Production Department A	180	2,700	....	60.75
7	15	Production Department A	170	2,550	....	57.38
8	40	Production Department A	150	6,000	....	135.00
9	40	Production Department B	160	6,400	....	144.00
10	25	Production Department B	184	4,600	....	103.50
11	10	Production Department C	160	1,600	....	36.00
12	10	Production Department C	130	1,300	....	29.25
13	25	Production Department D	150	3,750	....	84.38
14	10	Production Department D	192	1,920	....	43.20
			2,001	37,935	$0.0225	853.54
Actual cost						781.16
Surplus						$ 72.38

[1] The number of hours each motor is run is ascertained by cards like Fig. 16. The operating costs for individual motors are compounded with other charges in Table XXII to get the entries for column 12 on Fig. 6.

Eventually it is necessary to establish the load conditions for each motor by test. Later the motor costs on Table XX are apportioned as shown in Tables XXI and XXII.

The charges for shafting include depreciation, taxes, insurance, oiling, belt maintenance, etc. If one motor drives a shaft used by several departments, the cost of that motor should be added before a distribution is made. As in the problem, all shafting is within the separate limits of the several departments, the charges which follow are merely added to the motor costs in Table XXII.

GENERAL SHAFTING CHARGES

Production Department A	$ 67.18
Production Department B	67.18
Production Department C	33.59
Production Department D	55.98
Total	$223.93

Table XXI shows the calculation and distribution of compressed-air costs. Table XXII develops the complete electric power costs used in column 12, Fig. 6, the Departmental Cost Distribution Sheet.

TABLE XXI.—COMPRESSED-AIR COSTS AND THEIR DISTRIBUTION[1]

Costs:	
Motor No. 1	$118.12
Other charges, Table XIX	85.58
Total	$203.70
Distribution:	
Production Department A (50 Per Cent)	$101.85
Production Department B (30 Per Cent)	61.11
Mechanical Department (15 Per Cent)	30.56
Technical Department (5 Per Cent)	10.18
Total	$203.70

[1] The compressed-air costs are used with other costs in Table XXII to get the entries for column 12, Fig. 6.

Just how far to carry the electric-power cost calculations is a moot question. In the example the lighting costs could have been overlooked without seriously endangering the accuracy of the final result; nevertheless no matter how much they are condensed in the monthly distributions,

TABLE XXII.—POWER: ELECTRIC, ETC., FINAL COST DISTRIBUTION[1]

Production Department A:		
Motor No. 6	$ 60.75	
Motor No. 7	57.38	
Motor No. 8	135.00	
Shafting	67.18	
Compressed Air	101.85	
Total		$ 422.16
Production Department B:		
Motor No. 9	$144.00	
Motor No. 10	103.50	
Shafting	67.18	
Compressed Air	61.11	
Total		375.79
Production Department C:		
Motor No. 11	$ 36.00	
Motor No. 12	29.25	
Shafting	33.59	
Total		98.84
Production Department D:		
Motor No. 13	$ 84.38	
Motor No. 14	43.20	
Shafting	55.98	
Total		183.56
Warehouse:		
Motor No. 3		$ 9.29
Real Estate Department:		
Lighting		19.75
Mechanical Department:		
Motor No. 5	$ 27.00	
Compressed Air	30.56	
Total		57.56
Power: Steam		
Motor No. 2		3.60
Technical Department:		
Motor No. 4	2.07	
Compressed Air	10.18	
Total		12.25
Power: Electric, etc. Distributed Cost		$1,182.80
Cost Variation:		
Motor Surplus	$ 72.38	
Lights Surplus	.74	
Less Net Surplus		73.12
Power: Electric, etc. Actual Cost		$1,109.68

---

[1] These values are used in column 12 on Fig. 6.

they should, at least once a year, be followed with great fidelity into every remote corner as a safeguard against setting up on the books figures which have long outlived the facts. The complete calculations can be performed with great rapidity after the clerks have passed through the period of apprenticeship.

Technical Department.

Whenever the scale of operations is sufficient to warrant it, standard costs should be set for routine tasks of the technical department. This method is so conducive to a critical examination of activities that it becomes a great agent for reducing costs. In the smaller factories an average hourly rate and a good old-fashioned time book will give excellent results. This method has been used in the example. On the distribution sheet of Chap. V, an hourly rate of $2.25 is used to extend the 735 active working hours of technical help. Much information of value on the technical department will be found in "The Technical Organization" by Weiss and Downs, published by the McGraw-Hill Book Company, Inc.

Supervision.

To correctly interpret the logic of events underlying a distribution of the cost of maintaining the function of supervision is more difficult than for any of the other service activities. When we begin, minutely, to investigate the acts of the *higher-ups* we tread on sensitive ground. A diplomatic approach to the problem can be had by tactfully giving the general superintendent a copy of Schell's "The Technique of Executive Control," published by the McGraw-Hill Book Company, Inc., New York and Lord's "A Plan for Self-management," published by The Ronald Press Company, and letting him work out an equitable distribution of his time.

Two methods of handling supervision costs are open to us, for we can allocate them according to a daily time record or according to a fixed percentage deduced from a theoretical consideration of each department's routine needs. Of the two answers, the last is by far the most tempting. There is no justice in penalizing one department because another has failed to fulfil its market obligations. The charges against production departments A, B, C, and D (column 14 of the distribution sheet, Chap. V) represent the following fixed percentages on the total supervision costs for January:

Production Department A	35 per cent	$232.79
Production Department B	25 per cent	166.29
Production Department C	15 per cent	99.77
Production Department D	25 per cent	166.29
	100 per cent	$665.14

Restaurant.

The isolated location of a chemical factory often makes it necessary to go into the restaurant business for the benefit of the employees. Such ventures are rarely self-supporting, but they do bring in some revenue. Most logically a restaurant is a service department whose operating loss is chargeable to the labor-maintenance department for distribution to the other business divisions.

As it illustrates other possibilities in handling accounts on the departmental distribution sheet (Fig. 6), we will assume that the operating loss of the restaurant is to be charged to the labor-maintenance department and that there is no vertical column available for handling the account. We set aside a horizontal line among the service departments for the restaurant and another one for the revenue from sales in the added facility group. As we are using the same vertical column for both the labor-maintenance department and the restaurant, we enter an amount equal to the revenue from restaurant sales in this column on the appropriate horizontal line. This value is a service distribution and not an original entry according to the theory on which the sheet is based. To get the cost variation for this vertical column, it is necessary to merge the actual cost of running the restaurant with that of the labor-maintenance department before subtracting from the total standard cost distributed in the column. The combined costs can be resolved into their components on an auxiliary sheet.

To distribute the restaurant costs in the foregoing way leads to just enough complications to make one think that it is far wiser to accept the outcome of the restaurant operations as a loss and enter it on the books as a loss. If this principle is adopted, then the accounting technique becomes very simple. Instead of making a service department out of the restaurant, it is treated as an account in the added facilities group. The profit or loss on operations can be easily cleared in the general books of account. In all of cost accounting considerable restraint is required to keep from carrying the distributions too far. Many of them have been placed in this book not to prove that they should be made, but merely to show what can be done when the proper occasion arises.

Miscellaneous Service Activities.

A safety department at times assumes such proportions that its costs must be separately analysed before they are merged with the labor-maintenance department. A fire department occasionally presents a similar problem before its costs are combined with the fire-insurance charges. When steam, electricity, mechanical labor, and other services are sold to outside concerns, a sales account in the added facilities group is needed to clear these values at cost.

CHAPTER VII

PROCESS COSTS

Process Cost Defined.

In this book, the word *process* connotes manufacturing methods and although materials are implied, the thought is directed, in an all inclusive sense, at the agencies of change which work over raw materials into new products. As no limits are imposed by the expression, *process* may be used to signify an entire manufacturing method or any logical part of it. Process cost refers to the expense of performing the productive changes defined in this section.

Standard Cost Defined.

Costs go up and costs go down. Among the shifting values there is one which represents the mean average cost of the yearly output. We find it, study it, remodel it to the coming year's market conditions, pare it down a little so that the organization must reach out to attain it, and that is our standard cost.

Standard Costs Give All the Facts.

Since so many people, with great effort, continuously seek the actual cost of the moment, it becomes necessary at this time to show why the procedure is unnecessary and misleading. If it is our intention to feel buoyant today when we are shown low costs, and depressed tomorrow when we are shown high costs, then by all means we should seek the actual article costs of the moment. A business, however, exists not for emotional appeal, but to win a profit consistently over a long period. This end is best served by unraveling economic causes through a careful comparison with type performance.

Suppose we use a raw material which, through slight differences over the last shipment, cuts down the number of articles produced 10 per cent. No one will dispute that our costs for the lot have increased. We follow the usual procedure and as the production has been running at a substantially higher rate no appreciable change in costs is noted on the records—the loss in yield having been offset by a gain in the rate of production. A busy manager, noting the apparently proper cost, would pass over to other things and never realize the existence of a situation which requires executive attention. Had the accounts been properly measured in terms of standard performance, he would have been apprised of a surplus cost variation arising in a greater productive rate and a deficit cost variation arising through a loss of yield from essential raw materials.

There are changes in business values which, in themselves, bear a significant message, yet when they are tediously disseminated over a vast array of momentary costs, they either frighten or bring a feeling of unwarranted satisfaction. Two companies, each the greatest in its line, have carried this thought a step further for they have struck at disturbing fluctuations in their very profits. The financial reports of both are so expressive on this subject that the related portions are quoted verbatim.

EXTRACT FROM THE ANNUAL REPORT OF THE INTERNATIONAL HARVESTER COMPANY

December 31, 1921

> In the early years of the war, the Officers and Directors realized that the advance in prices of raw materials would affect this industry in a peculiar way. It was evident that if the inventory were valued according to high war-time prices, the profits would be materially increased; and when, after the war, the inevitable decline in prices occurred, the Company would be confronted with large losses due to such declines. The Company is compelled to have on hand constantly an inventory of raw materials, work in process, and finished machines of at least 50 per cent of the gross sales of a normal year. The turn-over in this business, that is, the period between the purchase of raw materials and

the sale of the manufactured product, averages about twelve months; whereas in some lines of production the turn-over is made in a much shorter time. This longer period of turn-over is due to the fact that the Company's manufacturing program is not based upon definite orders for goods but is necessarily made upon estimates of future crops and the probable need of machines, which must be manufactured and distributed throughout the agricultural districts of the world in sufficient time to be available when needed upon short notice.

A normal inventory of materials and parts sufficient to protect ordinary manufacturing operations is as much a fixed investment with this Company as real estate, factory buildings, or machinery.

In view of these facts it was decided that so much of the inventory as represented the portion constantly on hand (termed the basic inventory) should be valued at pre-war (1916) prices and carried on the balance sheet at those prices; and that fluctuations in values should be reflected only in the amount of the inventory carried in excess of the basic inventory. This policy was adhered to even though the United States Government for taxation purposes valued the entire inventory at cost or market prices, thus resulting in the payment of taxes on profits never realized.

The inventory at the close of 1921 was valued at the then cost or market, whichever was lower, and is so valued in this balance sheet. The Company shows a net profit for the year 1921, notwithstanding the decline in value of the inventory. Had not the Company adopted conservative methods in valuing inventories during the past few years the balance sheet for 1921 would have shown a net loss in excess of $20,000,000.

EXTRACT FROM THE ANNUAL REPORT OF THE ANACONDA COPPER MINING COMPANY

December 31, 1926

The metals in the inventories on hand and in process, due to the extensive operations of your Company and its subsidiaries, aggregate in value large sums of money and the total quantities from year to year are relatively constant. They consist largely of purchased metals due to the large purchases made by The American Brass Company and to the metals contained in the ores and concentrates purchased by the Zinc Plant of your Company and the Lead and Copper Plants of the International Smelting Company. Consequently, an advance or decline in metal prices had a tendency to distort yearly profits and the decrease in profits for the year 1926 as compared with 1925 is attributed mostly to carrying purchased metals in inventories at lower prices at the close of the year than at the beginning. It has been decided that the normal quantities of metals carried in inventories should be regarded as fixed and carried at such conservative fixed prices as to make it improbable that they will be affected by adverse market conditions. The amount of $3,362,288.87 was therefore set aside in an inventory reserve after the close of the 1926 accounts and deducted from surplus as shown in the consolidated balance sheet attached hereto. Future inventories will be carried on the same basis.

We need not go beyond standard costs because after a business has been completely surveyed in terms of them, we have learned the key facts. Since selling prices, depressed with ease and raised with difficulty, cannot be altered to meet every momentary value, the extra labor needed to establish actual article costs is wasted. By confining all cost discussions to standard values and their variations, executive, accountant, and operator all commence to talk an accounting esperanto instead of trying to make themselves understood through a babel of figures. Seasoned standard costs undoubtedly are quite capable of telling the entire business story.

Developing Standard Costs.

The development of cost standards usually is associated with stop watches, moving picture cameras, and a vivid imagination, when really all that is needed is a thick black pencil, a large sheet of paper, patient industry, and a well-ordered cost system to verify the accuracy of the deductions In nearly every case results obtained in this way will satisfy even the most meticulous. The more detailed researches on every phase of a process are helpful in improving methods and in lowering costs, but they are not required to establish the real seasoned costs of production which are to be adopted as the standards of performance.

Every factory meets restrictions in markets and in equipment which preclude the lowest costs from becoming the long time average costs. In the development of standards of performance we must ever bear in mind that our real purpose is to set up as types those results which we have every reason to believe can be reproduced consistently. The quantity you really can sell practically dictates the divisor used to get unit costs.

The actual work of preparing cost models is tedious but not difficult. By beginning with the accounts of the general ledger, a well-ordered plan for the calculations is assured. Organizing the business into departments and setting up the distribution sheet of Chap. V puts us on the road to collecting the essential basic facts. The data thus secured, after being weighed in terms of output, can be fashioned into crude cost standards. No matter how hopeless the types may seem at first, continued efforts will gradually work them over into reliable models of performance. This method of approaching the cost-standard problem insures a wealth of statistics from which to judge the true situation.

How Far Should Standardization Be Carried?

The question naturally arises, how far should this campaign of standardization be carried? To this each must find his own answer. Opinion will rule as to the reasonable limits of this endeavor. As with the profits of a business, the law of diminishing returns finally becomes active and further refinements no longer show results commensurate with the required labor. Service costs should always be standardized for they contribute largely to mounting costs in slack times and they are not readily susceptible to distribution on any other basis.

Units for Process Costs.

Great care must be exercised in selecting for each process the unit of measurement best suited to it. Thought on this subject leads us into an analysis of processes. Undue haste in approaching article costs has led to classifications such as job costs, class costs, operation costs, etc., which really confuse the major issue. From an accounting standpoint the factory has to consider only two kinds of processes

—those applied entirely to one article and those applied to a number of different articles. In this instance, joint products are considered as a single article.

Processes used in the production of only one article are amenable to simple accounting methods. Frequently, with this type, we are able to forge together into one process a large number of different operations without bringing any of them to a separate cost focus. Where the work of cost finding is great this is an advantage, for the burden can be lightened by continuously controlling the larger group and only periodically investigating the underlying details. When the relationship of input of raw materials to output of finished stock is constant, this type of process can be measured directly in terms of finished articles, but when this relationship is variable, units based on the entering constituents must be selected. For the last condition such unit costs as per ton of essential raw material, per batch, per lot, or per days of operation are used.

The multi-product process can never be measured directly in terms of finished articles. Appropriate cost units for these processes will invariably be found in some form of machine rate. Hence we find them reduced to such things as cost per hour of machining, per pound of water evaporated, per square foot of surface finished, per pound of metal cast, etc.

The problem is sometimes attended by annoying complications. The following editorial from the April, 1925, number of *Mines and Metallurgy* referring to the selection of units in one of the stages of copper production, points out some of the difficulties encountered.

EXTRACT FROM MINES AND METALLURGY, APRIL, 1925

Unit Costs in Metallurgical Accounting

There is no operation in the whole range of metallurgical accounting more tricky in its consequences than the reduction of a carefully constructed and accurately found operating expenditure to "unit cost."

. . . . .

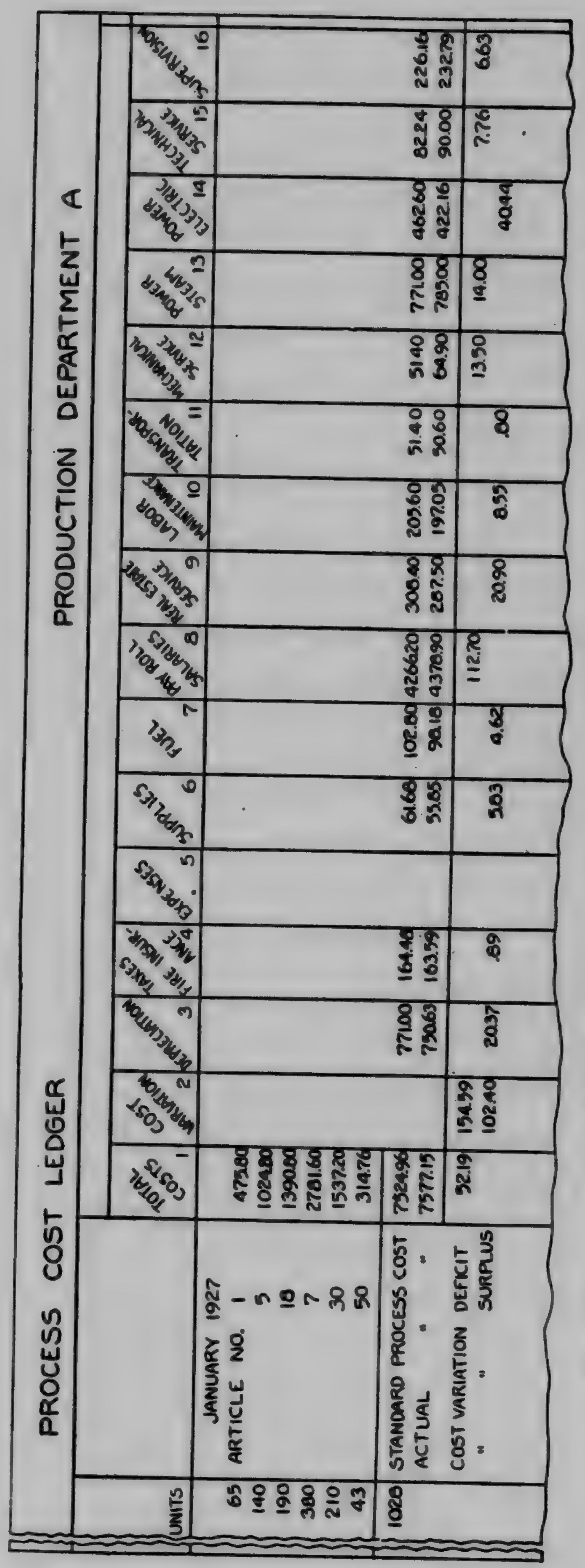
Perhaps the most striking instance of anomaly in the choice of divisors is to be found in the unit cost of converting matte. The divisor usually selected is the tonnage of copper produced, although the converter, instead of extracting copper from matte, extracts sulfur and iron and leaves the copper isolated; its significant tonnage is therefore the weight of the discard, not that of the values retained. Obviously grade of matte has a good deal to do with converting cost, and some smelters are now basing calculations on a careful correlation of the two.

Process-cost Standards.

All cost standards should be supported by quantitative facts. Such data simplifies the calculation of new values to meet changing price levels. Often a hypothetical, but probable economic situation must be considered. If the base of the standards is known, then the study of possibilities can proceed unhampered.

In some cases it will be necessary to have the process-cost standards arranged in steps so that, at the fiscal cutoff, fractional charges can be set up on the books to evaluate correctly the exact worth of uncompleted work. Whether this refinement is introduced or omitted depends entirely on the ratio between a single unit-process cost and the total departmental expense. When the standard values are comparatively small, the work started can be charged for, as though it were complete at the end of the fiscal period.

Table XXIII gives the unit-process-cost standard for Production Department A. As the process under discussion is used in the manufacture of many different articles, it is of the machine-rate or multi-product type. The cycle of operations is short and the comparative value of the standard is small, hence the entire amount can be charged at the time operations are started without jeopardizing the accuracy of the accounting. Attention is called to the fact that cost standard in Table XXIII is computed in terms of the column headings of the Departmental Cost Distribution Sheet (Fig. 6). On any other basis it is difficult to make proper cost comparisons.



PROCESS COST LEDGER PRODUCTION DEPARTMENT A

UNITS		TOTAL COSTS 1	COST VARIATION 2	DEPRECIATION 3	TAXES FIRE INSURANCE 4	EXPENSES 5	SUPPLIES 6	FUEL 7	PAY ROLL SALARIES 8	REAL ESTATE SERVICE 9	LABOR MAINTENANCE 10	TRANSPORTATION 11	MECHANICAL SERVICE 12	STEAM POWER 13	ELECTRIC POWER 14	TECHNICAL SERVICE 15	SUPERVISION 16
	JANUARY 1927																
65	ARTICLE NO. 1	475.80															
140	5	1024.80															
190	18	1390.80															
380	7	2781.60															
210	30	1537.20															
43	50	314.76															
1028	STANDARD PROCESS COST	7524.96		771.00	164.48		61.68	102.80	4266.20	308.40	205.60	51.40	51.40	771.00	462.60	82.24	226.16
	ACTUAL " "	7577.15		750.63	163.59		55.85	98.18	4378.90	287.50	197.05	90.60	64.90	785.00	422.16	90.00	232.79
	COST VARIATION DEFICIT	52.19	154.59						112.70				13.50	14.00		7.76	6.63
	" " SURPLUS		102.40	20.37	.89		5.83	4.62		20.90	8.55	.80			40.44		

Fig. 17.—Process cost ledger, Production Department A. The form of Fig. 4 is again featured here.

1028) 7524.96 (7.32
7196
3289
3084
2056
2056

PROCESS COST MASTER SHEET	DEPRECIATION 1	TAXES FIRE INSURANCE 2	EXPENSES 3	SUPPLIES 4	FUEL 5	PAY ROLL SALARIES 6	REAL ESTATE SERVICE 7	LABOR MAINTENANCE 8	TRANSPORTATION 9	MECHANICAL SERVICE 10	POWER STEAM 11	POWER ELECTRIC 12	TECHNICAL SERVICE 13	SUPERVISION 14	TOTALS 15	TOTALS 16
JANUARY 1927																
DEFICIT COST VARIATIONS																
PRODUCTION DEPT. A						112.70				13.50	14.00		7.76	6.63	154.59	
" B				7.80			12.40		10.70	3.60	110.30	22.27	59.30		226.37	
" " C				2.01			12.59		4.30						18.90	
" " D				18.60						5.80		2.95	5.40		32.75	
TOTAL DEFICIT				28.41		112.70	24.99		15.00	22.90	124.30	25.22	72.46	6.63		432.66
SURPLUS COST VARIATIONS																
PRODUCTION DEPT. A	20.37	.89		5.83	4.62		20.90	8.55	.80			40.44			102.40	
" " B	92.14	31.40				412.11		34.30						22.13	592.08	
" " C	28.08	6.75				185.32		8.75		17.70		4.50	50.50	6.51	308.11	
" " D	50.27	10.15				110.90	33.37	4.61	15.38					24.62	249.30	
TOTAL SURPLUS	190.86	49.19		5.83	4.62	708.33	54.27	56.21	16.15	17.70		44.94	50.50	53.26		1251.89
NET DEFICIT				22.58						5.20	124.30		21.96		174.04	
NET SURPLUS	190.86	49.19			4.62	595.63	29.28	56.21	1.18			19.72		46.63	993.32	819.28
WORK IN PROCESS																
DEPT. A 7524.96																
" B 5833.57																
" C 4324.17																
" D 4873.02																
STANDARD COST																22555.78
ACTUAL COST																21736.44

FIG. 18.—Process cost master sheet. The form of Fig. 4 is again featured here.

TABLE XXIII.—PROCESS-COST STANDARD[1]

Production Department A

Depreciation	$ .75
Taxes, Fire Insurance	.16
Supplies	.06
Fuel	.10
Payroll	4.15
Real Estate Service	.30
Labor Maintenance	.20
Transportation	.05
Mechanical Service	.05
Power: Steam	.75
Power: Electric, etc.	.45
Technical Service	.08
Supervision	.22
	$7.32

[1] It is essential to calculate the standards in terms of the column headings on Fig. 6.

Process-cost Ledger.

The object of the process-cost ledger is to analyse each element of departmental cost in terms of the work actually performed, extended at standard cost. Figure 17 shows this simple calculation made on the same kind of ruled paper with the same column headings as the distribution sheet (Fig. 6, Chap. V). Entries in the process-cost ledger are only made after they have been set up on the work in process-cost sheet (Fig. 29), later to be discussed in Chap. XI. This procedure guards against omissions and duplications and yet lets the clerical work follow the easiest path.

Process-cost Master Sheet.

Figure 18 shows a master sheet for process costs. This tabulation serves two purposes: It prepares the figures for journalization, as described in Chap. XIII, and later makes it possible to trace the origin of cost variations quickly.

PART III

DETERMINING MATERIAL COSTS

CHAPTER VIII

MATERIALS IN THE WAREHOUSE

Materials Defined.

At the very beginning of cost work, we must draw a circle around the materials of production and set them apart, for their accounting technique differs from that used for the other cost elements. Materials must be handled with the same exacting care that is our habit when cash is involved. They must also be kept apart from supplies because the methods of control required for materials are far too costly to be applied to the nondescript, and often inconsequential supply items. It is for these reasons that at the very beginning we must list the materials of production.

As has been previously noted, they exist in three states—raw material, work in process, and finished stock. During the progressive passage through these three stages a material may lose its identity, stay the same, or be discarded as a waste product. To be classified as a material the object under consideration must fulfil two essential requirements. First, its use must vary in direct proportion to the production of a particular article. Second, it must add an appreciable amount to the finished-stock costs. Following these principles, we can include as materials things dissipated in process so as not to be present in the final product, even in an altered form, and we can exclude as materials all things whose contribution to costs is too trivial to warrant the expense of an elaborate accounting control.

Where Materials Can Be Controlled.

Although they will not all occur in every business, there are ten places where materials can be controlled:

1. By the seller when he ships goods.

2. By the warehouse when goods are received.
3. By the warehouse when goods are delivered for process use.
4. By the production department when goods are received.
5. By the production department when goods are put into process.
6. By the production department when goods are removed from process.
7. By the production department when goods are delivered to warehouse.
8. By the warehouse when goods are received from the production department.
9. By the warehouse when goods are shipped.
10. By the customer when he receives goods.

In addition to the foregoing, many technical controls are needed for quality; our present considerations, however, are quantitative and not qualitative. To develop a system of material control, we must weigh the story told at each one of these places so that we may decide just how to enter discrepancies on the books.

The Warehouse Material Story.

It is but natural that we should raise up the warehouse into a material-controlling agency, whose story is accepted as the one depicting the true facts with which all other records must be reconciled. The warehouse specializes in material handling and usually is better equipped to count, weigh, and measure goods than other factory departments.

To divide the warehouse register of articles into the two customary parts, raw material and finished stock, brings out the story clearer and gives better contacts with the supporting statistical data. In each case the books must describe three facts—quantities of goods received, delivered, and on hand. Some people like to add prices and values but that is a mistake because it diverts us from the real work of quantitatively controlling materials. The financial

and quantitative statistics on all materials are given at monthly intervals by the raw-material, work-in-process, and finished-stock ledgers discussed in Chaps. X, XI, and XII and few are the businesses which cannot navigate by dead reckoning for the remainder of the time.

Material Balances.

That a warehouse record must at all times show the balance on hand is an erroneous but popular impression. The major purpose of the registers is to show receipts and disbursements of goods at the stock room. If this work is done accurately the inventory will always lie within the record, though it may not have been brought to the surface as an actual entry.

The material on hand is often a question of supreme importance; nevertheless, this information being only part of a larger problem may leave us no wiser than we were before as to correct business action. Production planning requires at one and the same time a knowledge of the inventories of finished stock, work in process, and all the component raw materials, both in the factory and in the warehouse. Production planning is bigger than some clerk ordering against a minimum quantity—a beautiful theory which occasionally works. Production planning must be done well in advance and there is no substitute for the actual brain work. Limited working capital may hamper operations and necessitate frequent calculations, but they hardly can be allowed to descend to the level of a continuous performance. The remedy lies in having ample funds and not in voluminous records.

These thoughts on daily balances of materials have led to a digression on production planning. In order not to make the remarks merely destructive, Fig. 19 is injected as a suggestion on the far superior graphic methods of controlling production, sales, inventories, etc. The chart depicts a graphic control for finished stock; by analogy, similar methods can be used to insure adequate supplies of raw materials.

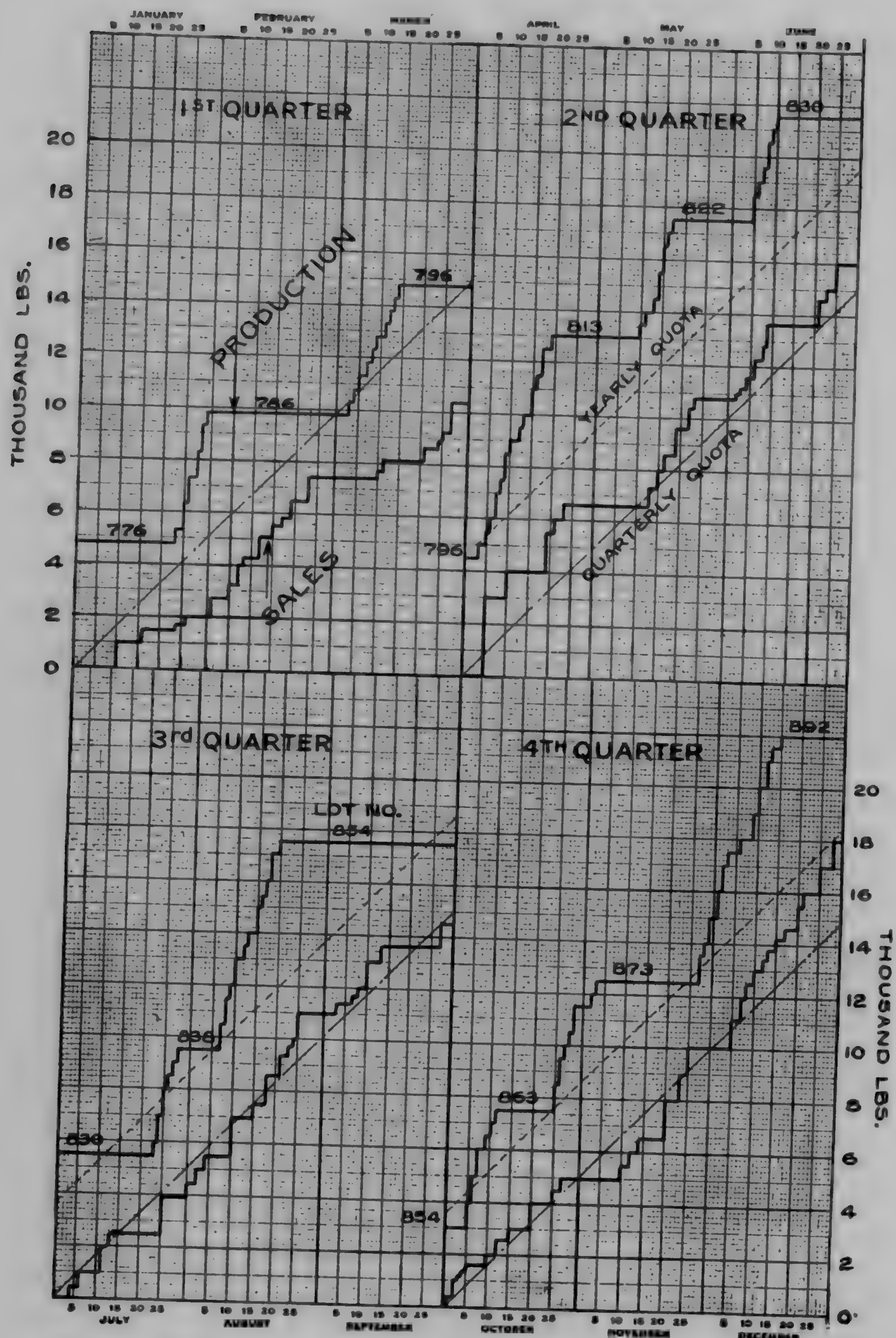
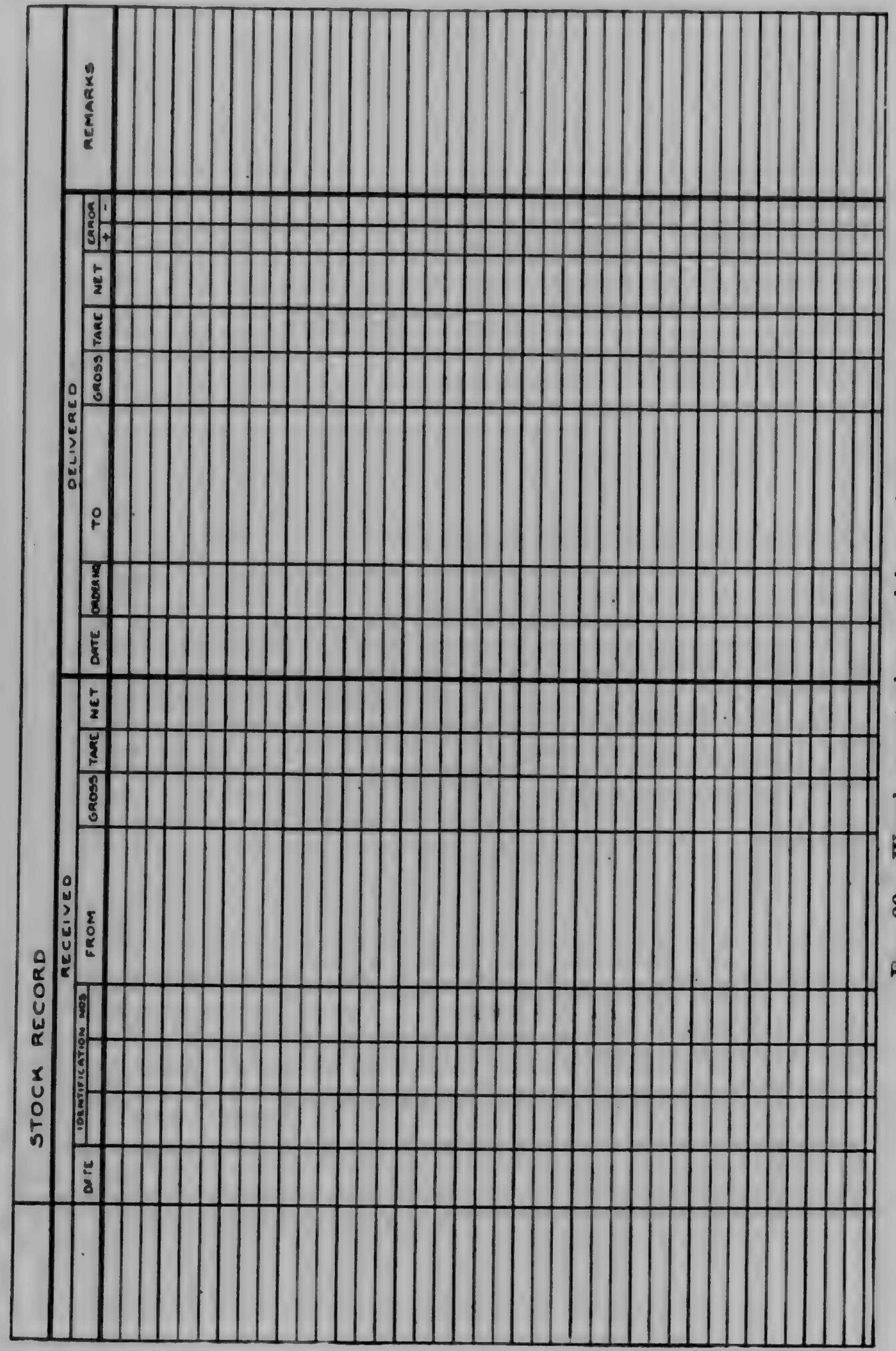


Fig. 19.—Graphic control of production. Codex Daily Record, Form 4217, is very useful for production planning. In order to reproduce the sheet it has been necessary to split it.

The chart is drawn on daily record sheet 4217 published by the Codex Book Co. of New York. A separate page is to be used for each article produced. As production planning is handled more conveniently on a quarterly basis, the sheet is divided into four parts. A sloping line is used to show in cumulative fashion the sales quota for each term. These four oblique lines need not be uniform, but can be varied to approximate the fluctuations of a seasonable business. In the second, third, and fourth quarters the period sales line is supplemented by a parallel reference line showing our position with respect to anticipated annual sales. In other words, if at the end of the first quarter we are a thousand units short in our sales, then in the second period a parallel oblique line is drawn a thousand units above the cumulative sales quota line for the period. The lower stepped or sales line is drawn by going up vertically an amount equal to the sales for the day. At all times it shows the total sales for the period and our position with respect to anticipated sales, for the period and for the year.

The upper stepped or production line is obtained by marking off the factory in process and warehouse inventory at the beginning of the term. A horizontal line carries this value along until a new batch is started. On that day we move up vertically an amount equal to the potential increment to the inventory and then go along horizontally until another batch is started. Yield variations will cause inaccuracies in the production line and these should be adjusted at the time they are discovered by lowering or raising the production line.

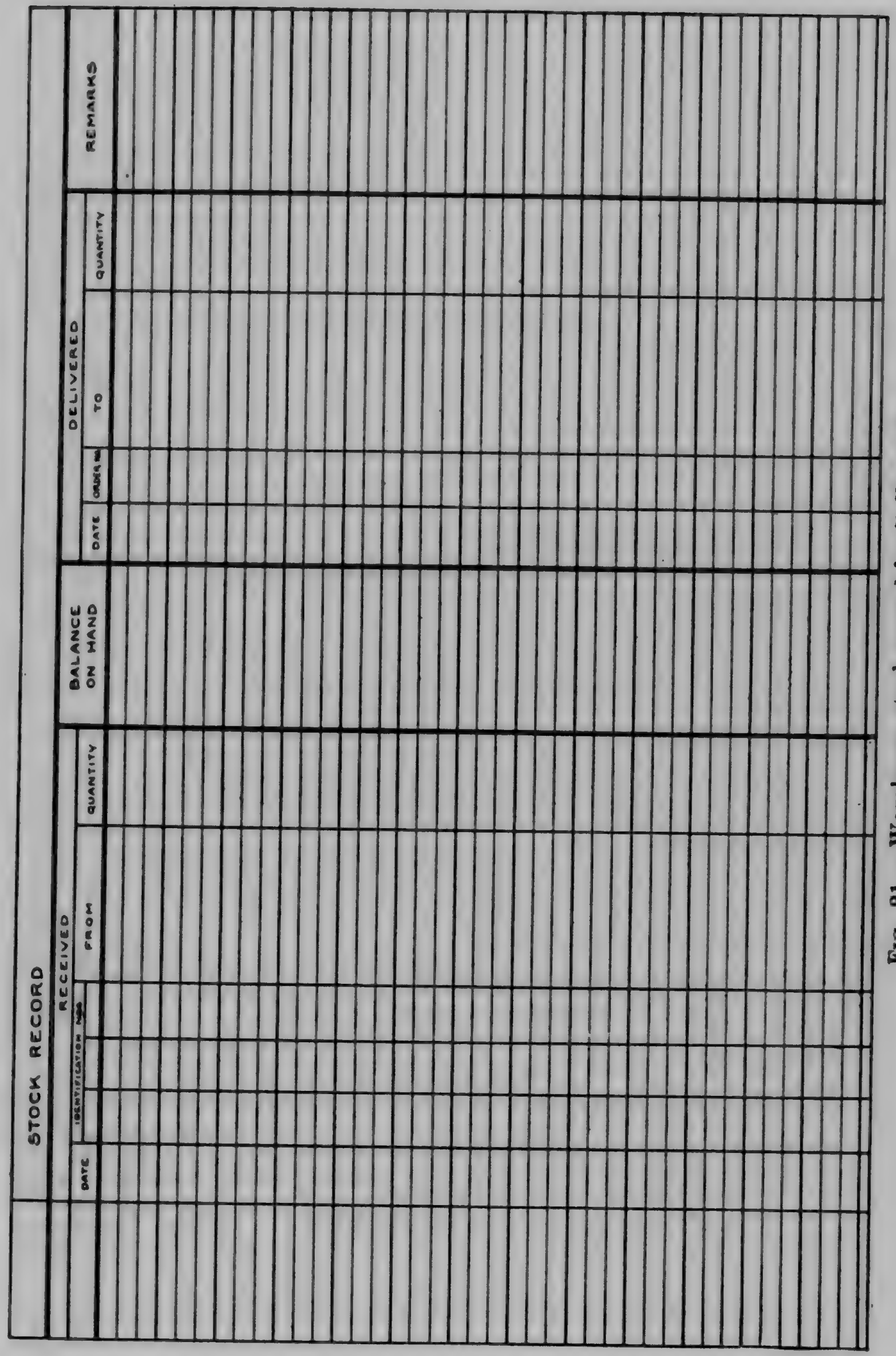
The difference between the sales and the production lines at all times gives the warehouse and the potential factory inventory. It is not wise to complicate the diagram by trying to differentiate between the two. This information can be obtained much more easily by consulting the stock records. The purpose of the chart is to show the trends on which the production campaigns are planned and not to give information as to lots available for immediate shipment.



STOCK RECORD

	RECEIVED					DELIVERED								REMARKS
DATE	IDENTIFICATION NOS.	FROM	GROSS	TARE	NET	DATE	ORDER NO.	TO	GROSS	TARE	NET	ERROR +	ERROR -	

FIG. 20.—Warehouse stock record for package goods.



STOCK RECORD

	RECEIVED			BALANCE ON HAND	DELIVERED				REMARKS
DATE	IDENTIFICATION NOS.	FROM	QUANTITY		DATE	ORDER NO.	TO	QUANTITY	

FIG. 21.—Warehouse stock record for bulk goods.

Kinds of Materials to Be Controlled.

From the standpoint of stock records, there are two kinds of materials: those that can be positively identified at the time of receipt and at the time of delivery, and those that completely lose their identity after being placed in stock. In the first class, we have all package goods or goods otherwise serially numbered in some positive manner. The second class includes all bulk goods and other goods which are not susceptible to permanent identification marks. Package goods, when opened, frequently join the second class. When the identity of goods can be established, the stock-control methods can be made more rigid. In a limited manner the same effect can be produced for bulk goods by segregating shipments.

Stock Records.

Figure 20 shows a stock record for use with package or serially numbered goods. As goods are put in stock they are individually listed on the received side and when they are issued that fact is noted against them on the same line on the delivered side. To get the balance on hand it is necessary to foot up the open items with an adding machine. Stock records should be kept in securely fastened looseleaf books and not on cards.

Containers in which goods are packed dry out in the course of time and lose weight. Sometimes the goods themselves lose moisture. By reweighing the gross, and the tare when it becomes available, the discrepancies can be ascertained for entry in the plus and minus error columns. Three columns are given for identification marks because some goods also have analytical data referring to their composition, which must be placed on the stock records.

Figure 21 shows a stock record for use with bulk goods. The balance column is provided for use at such times as it is desirable to foot up the receipts and deliveries. Whenever it is possible, separate shipments should be kept apart so that errors in issuing goods can be detected and limited to a particular lot at the earliest possible moment. To dump one shipment on top of another partially consumed throws the balance on hand into a quagmire of uncertainty from which it is difficult to extricate information of value.

Where Stock Records Should Be Kept.

The ideal place to run the warehouse records is in the business office. Most of the information contained in them is of far more importance to other department heads than it is to the boss of the stockroom. Warehouse men, in general, are unsuited temperamentally to desk work, whereas, that is the bread and butter of an office force. There are, undoubtedly, many cases where the stock records can be kept to better advantage in the warehouse, but this procedure should not be followed until the office has proved unsuited to the purpose.

Running the Warehouse with Vouchers.

If no records are kept in the stockroom, the office must be apprised of receipts and deliveries. Some of the existing factory records can be turned into vouchers for this purpose. Purchase orders and weight slips coming with shipments make satisfactory documents for attesting the receipt of goods from outside sources. Figure 22 suggests a voucher for the receipt of factory materials which can be modified to meet individual needs. The first coupon is retained by the production department sending in the goods; the second is sent to the office by the warehouse as a record of the receipt of the stock and the tag itself is sent to the office when the goods are shipped to a customer. Requisitions can be used to note the delivery of goods to the factory. Some people like to have the receipts and deliveries listed on a daily warehouse sheet; but it is better to let them stuff the vouchers in a device like a ballot box because the entries are usually made up at the end of the day and not at the time of the transaction.

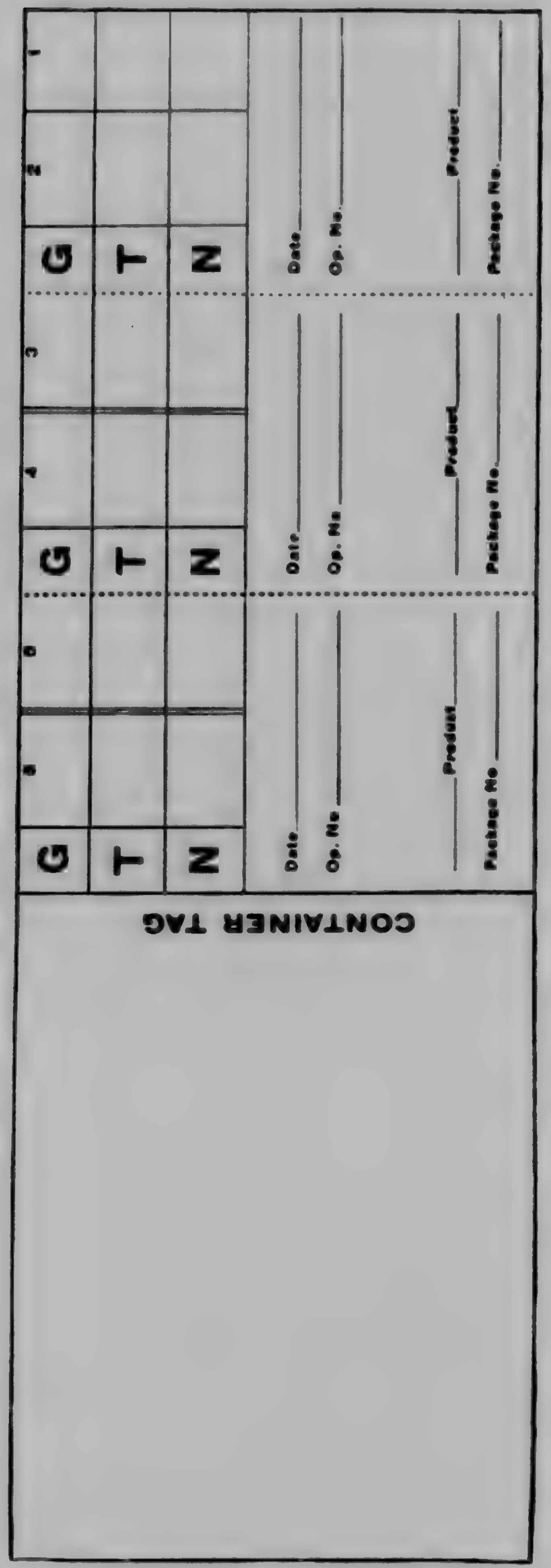


Fig. 22.—Container tag. The end flap is folded over and nailed down to protect the writing during storage.

Stock Records and Accounting Entries.

The inventory at the end of a fiscal period is the only accounting entry obtained directly from the stock records; receipts and disbursements verify other entries but they are not used directly for posting. If, as has been suggested on page 117, accuracy and completeness in recording receipts and disbursements of goods is made the major issue of the stock records, then the actual inventory on hand will at all times be faithfully depicted. To establish inventories by the old method of taking a physical count is an uncertain procedure because goods which are being transfered from one department to another are often overlooked entirely. Inventories taken from the stock books are not subject to that hazard, for, although materials may be placed in the wrong category, they will appear somewhere in the accounting.

Material Discrepancy File.

Unless discrepancies in the measurement and control of materials are officially entered in a classified file, or notebook, much valuable information becomes buried in the archives of the business. When errors indicate the need for better control on a specific material, these accumulations of past events become a source of inspiration for which there is no substitute.

CHAPTER IX

MATERIALS IN THE FACTORY

Where to Get Data on the Use of Materials.

Invariably books on cost accounting tell us that the proper way to report raw-material consumption is by means of requisitions. This suggestion bespeaks a lack of daily contact with requisitions, for, valuable as these vouchers may seem, they have distinct limitations in practice. Overlooking special cases, in general, their functions end when they have registered withdrawals of raw material from the warehouse. To burden them further leads to unnecessarily involved methods. The recording of raw-material consumption at the producing machine is a separate problem calling for written confirmations which have only that specific end in view. There is no reason why we should try to decipher the use of raw materials from requisitions when we can go to the producing department and with far less effort get the real facts.

Factory Stock Records.

There is no essential difference between raw-material control in the factory and in the warehouse: Each department receives goods and must show what was done with them. If we really want to know all about the use of raw materials in the factory, we must have the production departments keep books similar to those used in the warehouse, though possibly on a less pretentious scale. Therein must be shown receipts from the warehouse and disbursements to processes. It is easier for the producing unit to conduct this accounting than it is for the office, which is further removed from the transactions.

Controlling Factory Materials.

If we want to get the most appropriate methods for controlling factory materials, common sense suggests that we investigate the dependence of the final article on the initial unprocessed stock. Figure 23 shows the possible relationships between the raw and the finished stages. The various classifications will be discussed in subsequent articles. In each case the purpose is to ascertain the quantity of raw material to charge to a job, production order, lot, batch, or continuous operation, from which, after process costs have been posted, article costs can be developed. The design of factory material controls depends on these relationships and fortunate is the factory which needs to consider only one of the methods.

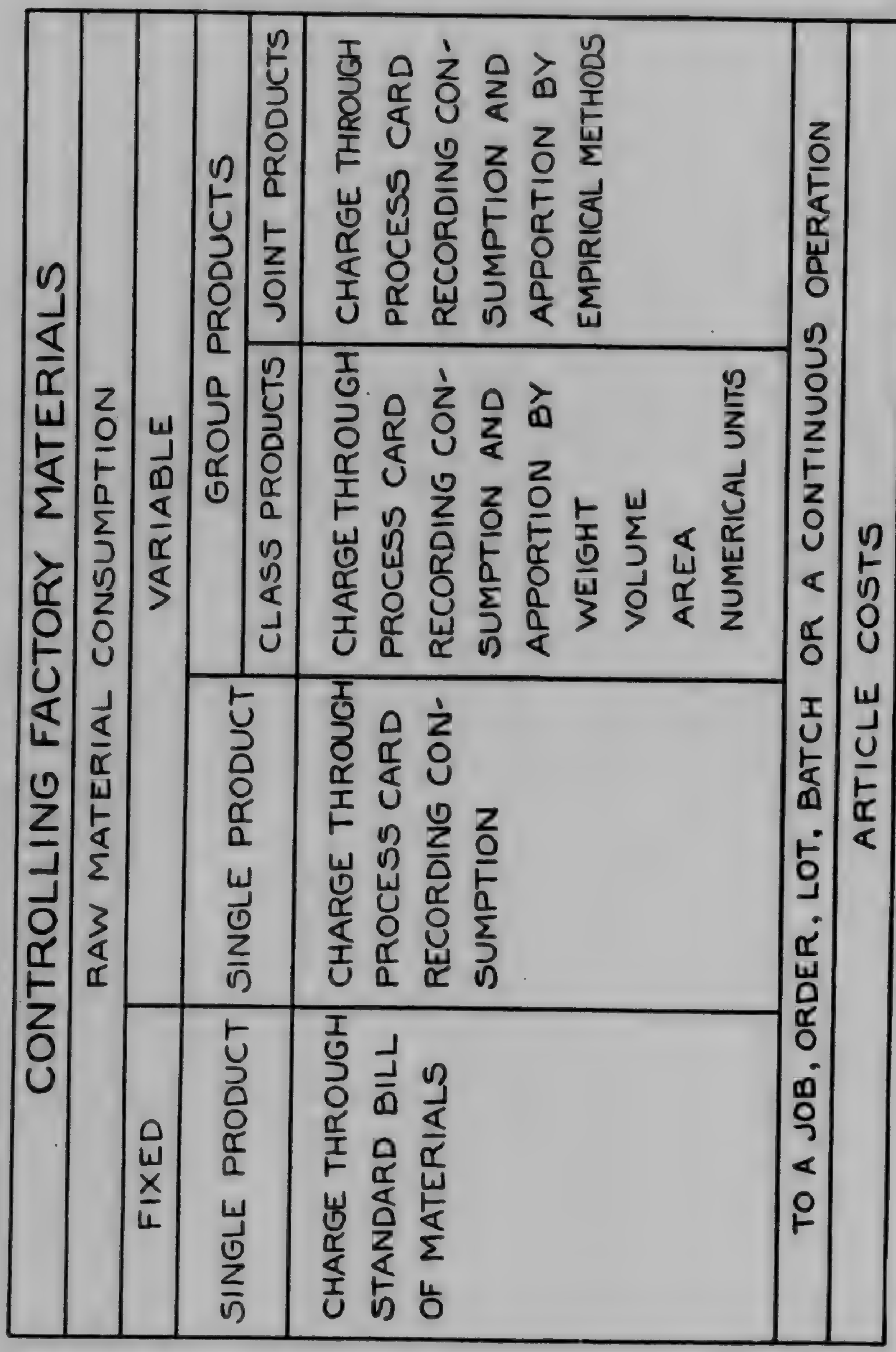
Raw-material Consumption Fixed.

In this discussion, the raw-material consumption is held to be fixed when each and every time a process is performed, exactly the same prescribed quantity of raw material is charged, or otherwise used, throughout the operation. The quantity of finished goods obtained from the given amount of crude stock does not enter into the picture and, therefore, may be either fixed or variable.

When there is no deviation from a prescribed raw-material consumption, and the accounting cutoff does not distort costs, we have the simplest possible situation in the factory with respect to materials. All that is necessary is to note carefully the contacts between process and inventory before extending a standard bill of materials by the amount of the production. When the fiscal period does affect costs, then the calculation must be amended so as to include a correct evaluation of uncompleted work, both at the beginning and at the end of the term.

Raw-material Consumption Variable.

When the consumption of raw material varies, then we must go to the operator for information. The production



CONTROLLING FACTORY MATERIALS			
RAW MATERIAL CONSUMPTION			
FIXED	VARIABLE		
SINGLE PRODUCT	SINGLE PRODUCT	GROUP PRODUCTS	
		CLASS PRODUCTS	JOINT PRODUCTS
CHARGE THROUGH STANDARD BILL OF MATERIALS	CHARGE THROUGH PROCESS CARD RECORDING CONSUMPTION	CHARGE THROUGH PROCESS CARD RECORDING CONSUMPTION AND APPORTION BY WEIGHT VOLUME AREA NUMERICAL UNITS	CHARGE THROUGH PROCESS CARD RECORDING CONSUMPTION AND APPORTION BY EMPIRICAL METHODS
TO A JOB, ORDER, LOT, BATCH OR A CONTINUOUS OPERATION			
ARTICLE COSTS			

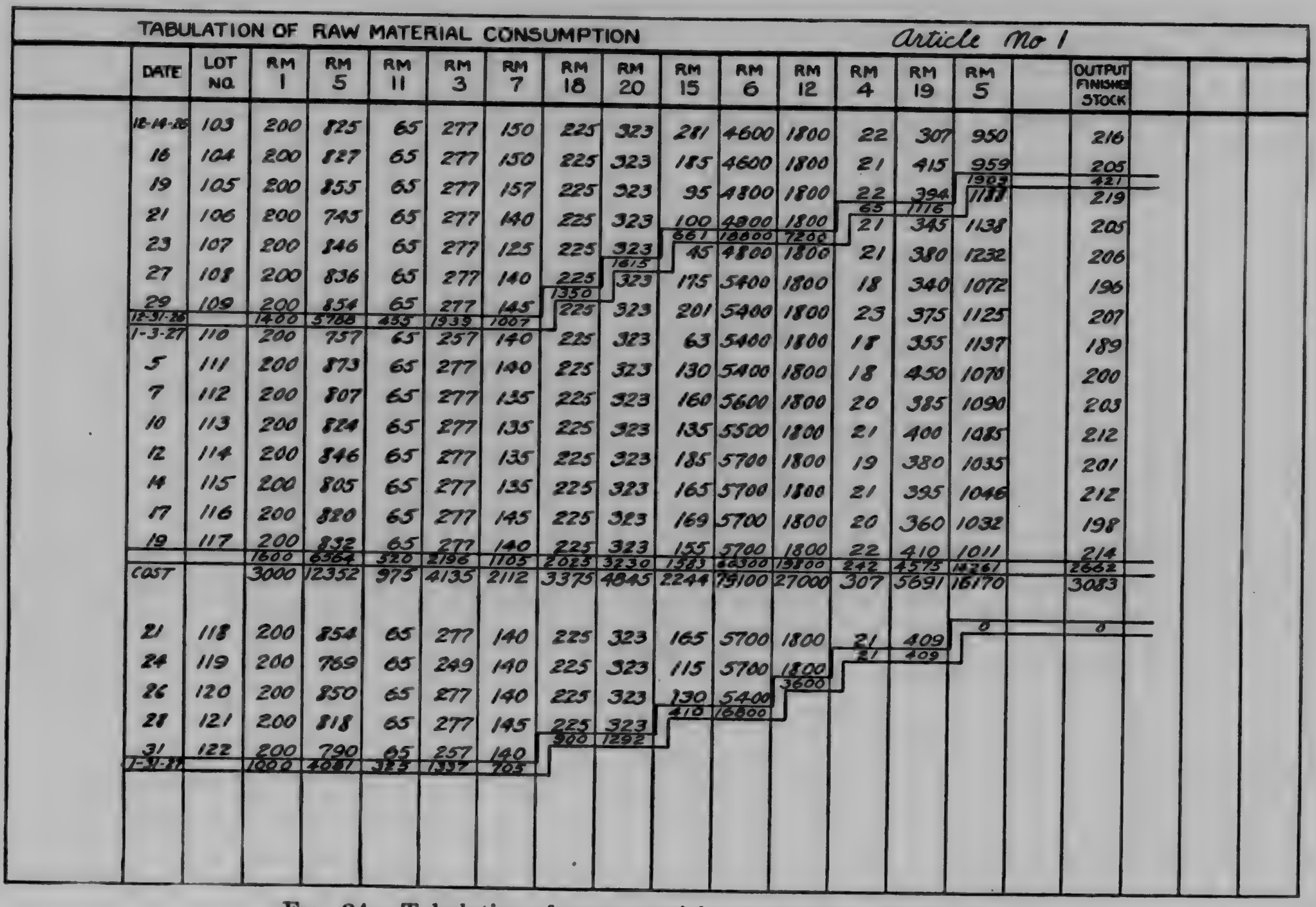
Fig. 23.—Controlling factory materials.

department can use product cards (see Fig. 9), notebooks, slips of paper, blackboards, or any other device as an original record, but at the earliest possible moment the data must be tabulated (see p. 130).

The more complex relations between raw and finished goods are found among the manufactures where variable quantities of crude stock are put into process. When only one article results, controlling records easily can be devised to follow the work through to the end, but when several products are made, the material must be apportioned among them. There are two kinds of group products: Articles that are connected essentially by volition are called *class products* in this book, and articles that are connected essentially by compulsion are called *joint products* The castings from a cupola charge are class products and the gasoline, kerosene, etc., from a fractionation of petroleum are joint products. With the one type we are able to exercise limited selective powers, but with the other type we must take what we get. The difference is important in the allocation of material values. For class products, the apportionment of raw materials is based on measurements; but for joint products the apportionment is empirical, being based on a combination of product yields and market demand—the tendency is to put the load on the articles which are able to bear it (see p. 147).

Tabulating the Consumption of Materials.

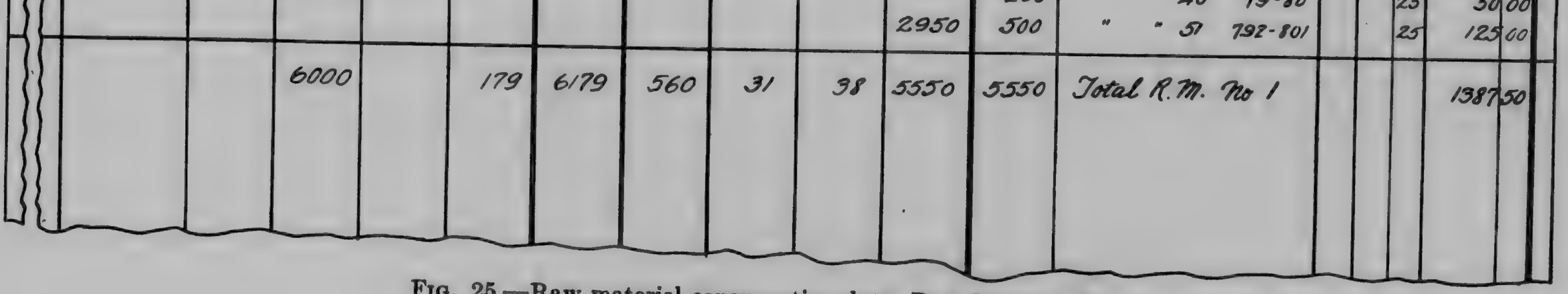
Figure 24 shows a widely used method of recording variable raw-material consumption. A separate line is devoted to each lot, batch, order, job, etc., and a separate column to each raw material. At the end of the fiscal period, a stepped line is drawn to indicate the accounting cutoff. The small figures between the parallel lines, usually written in red, give the raw-material quantities for posting on the work-in-process cost sheets. Several lines are skipped to indicate that article costs are to be taken for the run between this point and the last previous accounting.



TABULATION OF RAW MATERIAL CONSUMPTION Article No 1

	DATE	LOT NO.	RM 1	RM 5	RM 11	RM 3	RM 7	RM 18	RM 20	RM 15	RM 6	RM 12	RM 4	RM 19	RM 5		OUTPUT FINISHED STOCK			
	12-14-26	103	200	825	65	277	150	225	323	281	4600	1800	22	307	950		216			
	16	104	200	827	65	277	150	225	323	185	4600	1800	21	415	959 1909		205 421			
	19	105	200	855	65	277	157	225	323	95	4800	1800	22 65	394 1116	1188		219			
	21	106	200	745	65	277	140	225	323	100 661	4800 18800	1800 7200	21	345	1138		205			
	23	107	200	846	65	277	125	225	323 1615	45	4800	1800	21	380	1232		206			
	27	108	200	836	65	277	140	225 1350	323	175	5400	1800	18	340	1072		196			
	29	109	200	854	65	277	145	225	323	201	5400	1800	23	375	1125		207			
	12-31-26		1400	5788	455	1939	1007													
	1-3-27	110	200	757	65	257	140	225	323	63	5400	1800	18	355	1137		189			
	5	111	200	873	65	277	140	225	323	130	5400	1800	18	450	1070		200			
	7	112	200	807	65	277	135	225	323	160	5600	1800	20	385	1090		203			
	10	113	200	824	65	277	135	225	323	135	5500	1800	21	400	1085		212			
	12	114	200	846	65	277	135	225	323	185	5700	1800	19	380	1035		201			
	14	115	200	805	65	277	135	225	323	165	5700	1800	21	395	1046		212			
	17	116	200	820	65	277	145	225	323	169	5700	1800	20	360	1032		198			
	19	117	200	832	65	277	140	225	323	155	5700	1800	22	410	1011		214			
			1600	6364	520	2196	1105	2025	3230	1583	60300	19800	242	4575	14261		2662			
	COST		3000	12352	975	4135	2112	3375	4845	2244	79100	27000	307	5691	16170		3083			
															0		0			
	21	118	200	854	65	277	140	225	323	165	5700	1800	21 21	409 409						
	24	119	200	769	65	249	140	225	323	115	5700	1800 3600								
	26	120	200	850	65	277	140	225	323	130 410	5400 16800									
	28	121	200	818	65	277	145	225 900	323 1292											
	31	122	200	790	65	257	140													
	1-31-27		1000	4081	325	1337	705													

Fig. 24.—Tabulation of raw material consumption, Article No. 1.



RAW MATERIAL CONSUMPTION DATA Raw Material No. 1

REQ'D BY	DATE	REC'D	ERROR+	INVEN'Y	TOTAL	INVEN'Y	ERROR−	RETURNS	USED	USED	WORK IN PROCESS		PRICE	AMOUNT
Dept. C	1-3-27	500		179		560	19			1600	Article No 1 110-117		25	400 00
	7	500							2600	1000	" " 118-122		25	250 00
	12	500												
	17	500												
	21	500												
	26	500												
Dept. D	1-3-27	1000					12	38		850	Article No 32 570-571		25	212 50
	10	1000								1400	" " 33 308-311		25	350 00
	17	1000								200	" " 40 79-80		25	50 00
									2950	500	" " 51 792-801		25	125 00
		6000		179	6179	560	31	38	5550	5550	Total R.M. No 1			1387 50

Fig. 25.—Raw materiel consumption data, Raw Material No. 1.

For continuous processes the form is varied by devoting a separate line to each day in the month.

Checking Warehouse and Factory Records.

Figure 25 is used to check the warehouse and factory records on raw-material consumption. A separate sheet is required for each material to be controlled. After the consumption data, from a standard bill of materials, or from a tabulation sheet such as Fig. 24, has been posted on the work-in-process cost sheets, the facts are reassembled on Fig. 25, right-hand side, and checked to see that the total of the raw-material values on the work-in-process sheets agrees with the total of the controlling sheets (Fig. 25). Each sheet is then ready for a quantitative comparison with the warehouse disbursements.

Each lot of goods delivered to the factory is entered in the received column at the time of delivery. The factory inventories, obtained by physical count for the beginning and end of the period, are put in the proper columns. Returns to the warehouse are noted. A comparison of the figures reveals the difference between actual and reported consumption which can then be posted in the proper error column.

If this method of controlling raw material is followed conscientiously, the operating departments soon come to realize that the management does not differentiate between money and goods. Materials always will be wasted until the actual consumption is carefully analysed in this or some similar way.

Accounting Entries.

Four accounting entries are derived from the factory material records. The tabulation (Fig. 24) supplies the quantities for the work-in-process cost sheets. These same values are rearranged on Fig. 25 to get the amount of each raw material charged to work in process on the raw-material ledger. Besides these two entries, we get the factory raw-material inventory and the consumption discrepancy for posting in the ledger (Fig. 27).

CHAPTER X

RAW-MATERIAL COSTS

Designing a Raw-material Ledger.

In general accounting, entries are allowed to accumulate in the journals for a month before they are posted. The same thought is applicable to a detailed raw-material ledger. The period is long enough to amass a satisfactory volume of transactions, yet short enough to have all the events still stand out undimmed by time. As the year plays so important a role in business, it is well to assemble the facts for the 12 months on one sheet of paper. Figure 26 shows a raw-material ledger sheet designed to meet these views and Fig. 27 shows how the form is used.

Regardless of the particular raw material we investigate, we find its values are created and discharged through relatively few accounting entries. The initial or debit values appear as:

a. Inventories.
b. Purchase invoices.
c. Factory handling (unloading, cartage).
d. Accrued charges.
e. Accounting transfers.
f. Positive discrepancies (cost variation surplus).

The values are closed out on the ledger through:

a. Work-in-process consumption.
b. Non-productive use.
c. Sales.
d. Purchase credits.
e. Accounting transfers.
f. Negative discrepancies (cost-variation deficit).
g. Inventories.

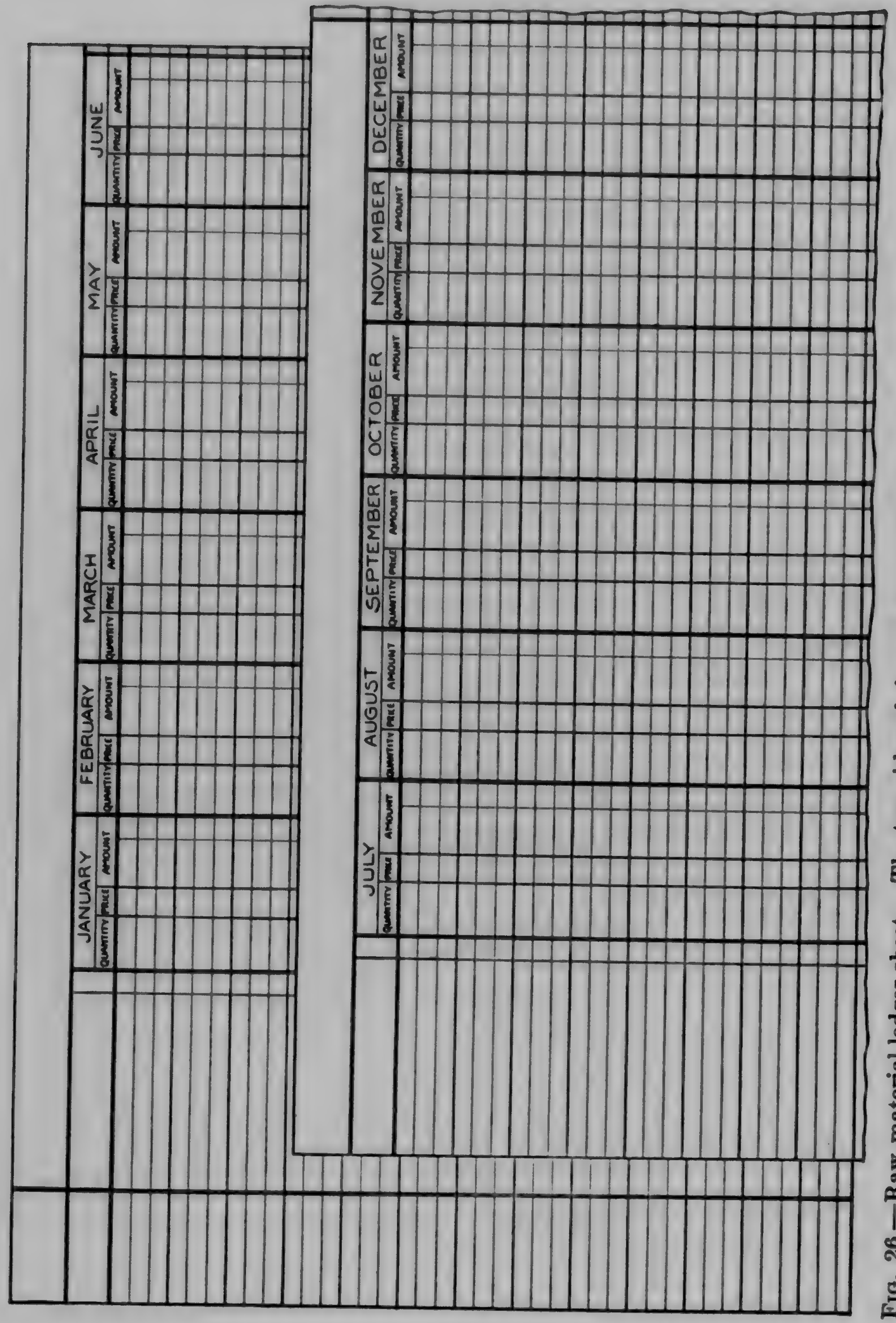
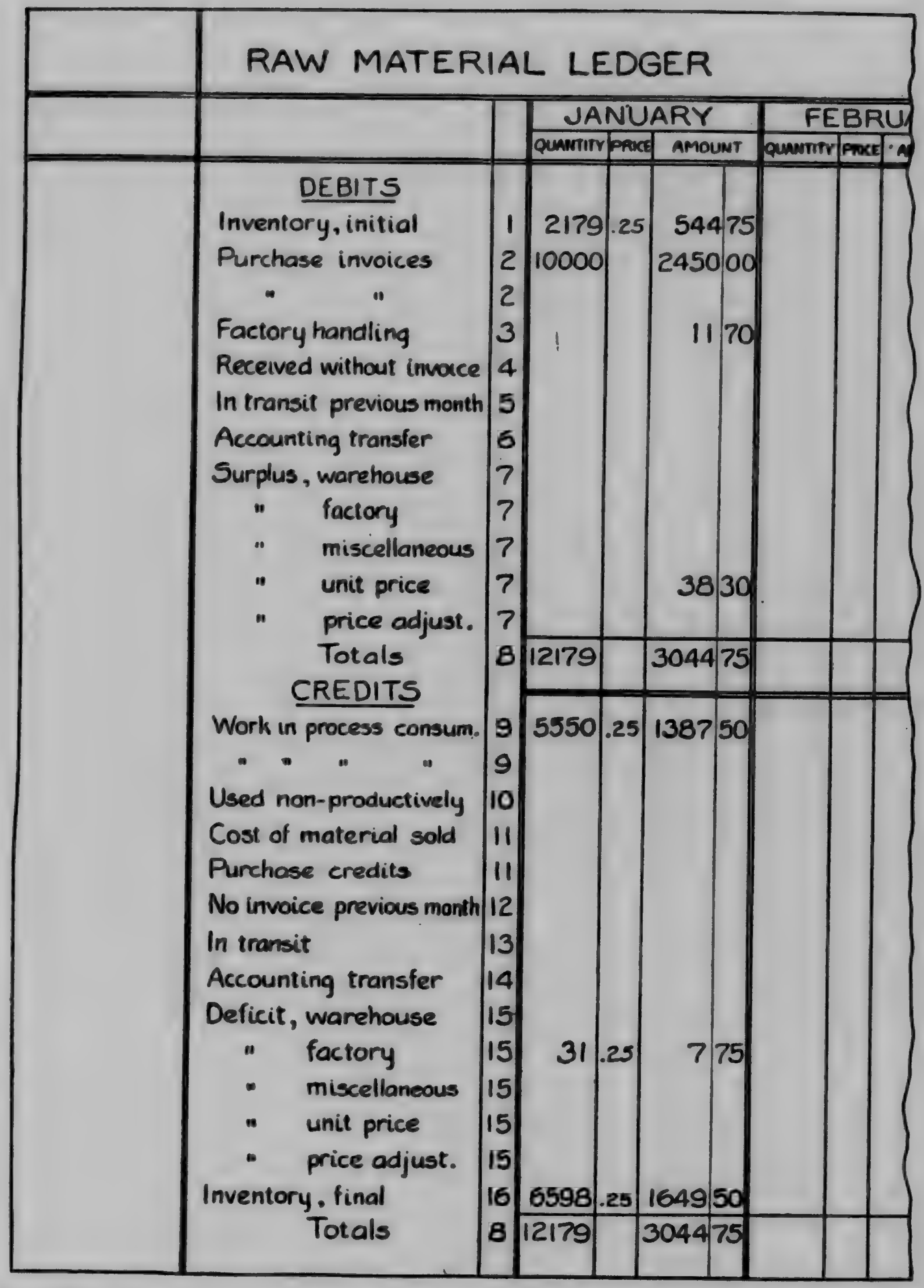


FIG. 26.—Raw material ledger sheet. The two sides of the raw material ledger sheet are shown here. The same form can also be used for the finished stock ledger sheet and for tabulating sales by customers.



RAW MATERIAL LEDGER

		JANUARY				FEBRU		
		QUANTITY	PRICE	AMOUNT		QUANTITY	PRICE	A
DEBITS								
Inventory, initial	1	2179	.25	544	75			
Purchase invoices	2	10000		2450	00			
" "	2							
Factory handling	3			11	70			
Received without invoice	4							
In transit previous month	5							
Accounting transfer	6							
Surplus, warehouse	7							
" factory	7							
" miscellaneous	7							
" unit price	7			38	30			
" price adjust.	7							
Totals	8	12179		3044	75			
CREDITS								
Work in process consum.	9	5550	.25	1387	50			
" " " "	9							
Used non-productively	10							
Cost of material sold	11							
Purchase credits	11							
No invoice previous month	12							
In transit	13							
Accounting transfer	14							
Deficit, warehouse	15							
" factory	15	31	.25	7	75			
" miscellaneous	15							
" unit price	15							
" price adjust.	15							
Inventory, final	16	6598	.25	1649	50			
Totals	8	12179		3044	75			

FIG. 27.—Raw material ledger details. This illustrates the use of the form of Fig. 26 as a raw material ledger sheet, for Raw Material No. 1.

Inventory Entries.

Inventory entry 1 on Fig. 27 is always the final inventory of the previous period. Entry 16 is practically always a book balance because the stock on hand is not apt to reach a low point, suitable for counting, exactly at the end of the fiscal period. Potentially, each inventory item has two parts: the warehouse component is found on Figs. 20 or 21 and the factory component on Fig. 25.

Purchase Invoices and Credits.

Not only bills for actual material, but also all invoices for freight, cartage, return freight on containers, etc. should be charged to the general-ledger account, Raw Material Purchase Invoices. The duplicate invoice file, which substantiates the original entry, is the proper source for obtaining the purchase-invoice amount of each individual raw material. Two lines are provided on Fig. 27 for entry 2; one is for the invoices which are complete and the other is for those of a fragmentary character. Invoices are said to be complete when the bills for the raw material, freight, cartage, etc., all were received within the same month. The incomplete invoices must be used in connection with accrued charges or adjustments to put the account into proper balance. All data must be analysed carefully, together with item 3, Factory Handling, to insure completeness before a unit cost is established.

Purchase Credits 11 covers goods returned to the vendor, allowances for shortages, quality, etc. When credits are received after the transaction to which they are related has been closed, the allowances are placed on the ledger as a matter of record, and are offset by a cost variation.

Factory Handling.

Where carting, unloading, and storing of raw materials is performed by the company's own organization, the expense of this work must be set up through item 3 to have the books reflect the true raw-material costs. The amount is obtained from the transportation departments' records (see p. 88).

Received without Invoice.

To expedite the work of accounting it is necessary to close the general books of account promptly at the end of the month. When this is done, goods frequently will be received before the invoice comes in by mail. To keep the ledger in balance, the cost of the goods must be entered as an accrual through item 4. If the invoice has not been received by the time the work on the raw-material ledger has progressed to that point, information as to the correct charge can be secured from the purchase orders. To adjust the ledger in the succeeding month, the accrual must be reversed by a corresponding entry through item 12.

In Transit.

Frequently, invoices are received before the goods are delivered. In such cases the values must be inventoried under item 13, in Transit, and offset in the following month by a corresponding entry through item 5.

Accounting Transfer.

Items 6 and 14, Accounting Transfer, are needed when material values must be shifted from one account to another. For instance, when bulk goods are put up in packages by the warehouse crew, such a transfer within the raw-material account is necessary if separate records are to be kept on the two items. The value packed would be transferred through item 14 to item 6 on a fresh ledger sheet and the cost of packing would be posted under Factory Handling, item 3.

Item 14, Accounting Transfer, is also used to shift raw-material values to the finished-stock ledger. When a material is both used in the manufactures and sold to other concerns, it is desirable to open up for this raw material a finished-stock ledger sheet on which the sales can be closed out by transferring through item 14 the exact amount sold.

Cost-variation Surplus and Deficit.

An accounting system should endeavor to show the origin of all material shortages, both quantitative and financial. To this end the five entries for cost variations in raw material have been devised. Although no one will dispute the possibility of variations being positive from a financial standpoint undoubtedly a few will contest the quantitative idea. The possibility of having surplus errors in the quantity of goods on hand is always present, because measurements are just as apt to be short as long when small portions are removed daily from a bin.

Surplus and deficit cost variations in raw material can be attributed to five agencies:

1. Warehouse.
2. Factory.
3. Miscellaneous.
4. Unit pricing.
5. Price adjustments.

By entering the errors of each separately on the raw-material ledger sheet, we put ourselves in a good position to take corrective action when the variations are disquieting.

The warehouse errors, like the factory errors, usually cannot be explained. When the book balance is checked with the quantity on hand and a difference is found, it simply must be written off as a warehouse cost variation. The size of it indicates the accuracy with which material has been doled out. In the factory we have a similar situation when the quantity of material available for consumption is compared with the amount recorded as entering processes. Close watch on these two departments will do much to curb shortages.

The miscellaneous variations are of two kinds, being due to disagreements with the seller's weights, or with warehouse weights previously noted on unopened goods. Both types become known in the warehouse. If we do not want to appear as a nuisance to suppliers we must pass over many small differences in weights which are too trivial to discuss. These variations are sometimes in our favor and sometimes to our disadvantage. Even though we quietly write them off they still appear on the records ready to be marshalled into an impressive array when the trend seems to justify a complaint.

Unit pricing variations show the efficiency of the purchasing department as they give the difference between the standard cost, previously set as the probable purchasing level, and the actual cost of the raw materials. Price adjustments, which elevate or depress the value of the stocks on hand, to more closely approximate market conditions, are occasionally necessary and, therefore, lines have been provided for this entry.

Work-in-process Consumption.

As the quantitative determination of goods put into process has been discussed in Chap. IX, the essential thought to be presented here is the matter of proper prices for use in evaluating these quantities. Whenever a raw-material price is changed, an equivalent correction must be made in all of the standard article costs. Time and energy are used up in recasting costs. To recognize every fractional change, even though it has no appreciable effect on ultimate results, is a wasted effort. A standard price should be selected for each raw material and used as such until market conditions indicate that a new price level must be established.

Item 9 comes from Fig. 25. In review, the raw-material consumption is tabulated on Fig. 24 for each article produced. At the end of a fiscal period or on completion of a production order, the columns are footed and the quantities are entered on the work-in-process cost sheets for pricing and extension. The data on these sheets are then rearranged on Fig. 25, according to raw materials, using a

RAW MATERIAL MASTER SHEET JANUARY 1927

	DEBITS								CREDITS							
	Inventory 1	Purchase Invoices 2	Factory Handling 3	No Invoice 4	In Transit 5	Transfer 6	Variation Surplus 7	Totals 8	Work in Process 9	Non Productive 10	Sold Credits 11	No Invoice 12	In Transit 13	Transfer 14	Variation Deficit 15	Inventory 16
RAW MATERIAL NO. 1	544.75	2450.00	11.70				38.30	3044.75	1387.50						7.75	1649.50
" " " 2	97.22	50.10	.60				2.93	150.85	42.72				50.10			58.03
" " " 3	160.74	594.16	8.10					763.00	483.67	12.12	c 5.10				3.95	257.96
" " " 73	1505.65							1505.65			s 1205.40					300.25
" " " 74	434.95			90.20			25.10	550.25	208.50						10.25	331.50
" " " 75	350.65	848.40	9.95		140.08		17.40	1366.68	650.30	5.18						711.20
TOTALS	33676.37	25875.90	155.60	175.80	201.19		350.65	60435.51	25611.14	37.98	1755.90 c 88.50	58.95	295.80	1709.00	692.50	30185.74

Fig. 28.—Raw material master sheet. The form of Fig. 4 is again featured here.

separate sheet for each one. Here the consumption is checked against the warehouse records; the errors are placed on the raw-material ledger as cost variations, and the work in process consumption is posted as item 9 on Fig. 27, the raw-material ledger.

Non-productively Used Material.

Small amounts of raw material are often used by the technical and other departments, in a non-productive way. Item 10, Used Non-productively, provides for the entry of these charges on the raw-material ledger.

Raw Material Sold.

Item 11, Cost of Material Sold, is used to credit the sale of raw materials when the goods are sold to reduce surplus stocks or to take a speculative profit. Only raw materials which are not regularly traded in should be put through the books in this fashion. Where the sale of raw materials is a regular part of the business activities, the quantities sold each month should be shifted to the finished stock account through item 14, Accounting Transfer (see p. 137).

The Master Sheet.

Although for general accounting work the individual raw-material ledger sheets are unwieldy, they easily can be put into a serviceable form by means of a master sheet. Figure 28 shows how this is done. The ledger pages are arranged in alphabetical or some other convenient order, and the financial values are entered on the horizontal lines of the master sheet. The posting can be simplified by numbering the items on Fig. 27 to correspond to the columns on Fig. 28. The footings give the needed entries for general accounting purposes.

CHAPTER XI

WORK-IN-PROCESS COSTS

Production Orders and Work-in-process Cost Sheets.

Production orders can be employed as convenient instruments for simultaneously requesting the manufacture of goods and the operation of the attendant cost records. From this thought we are able to evolve the principle of costing each production order. If this procedure is followed, the clerk who costs work in process finds the authorization for his tasks in a copy of the production orders. To simplify the work of cost finding and to increase its value, manufacturing activities must be requisitioned in those volumes which present the most effective accounting picture.

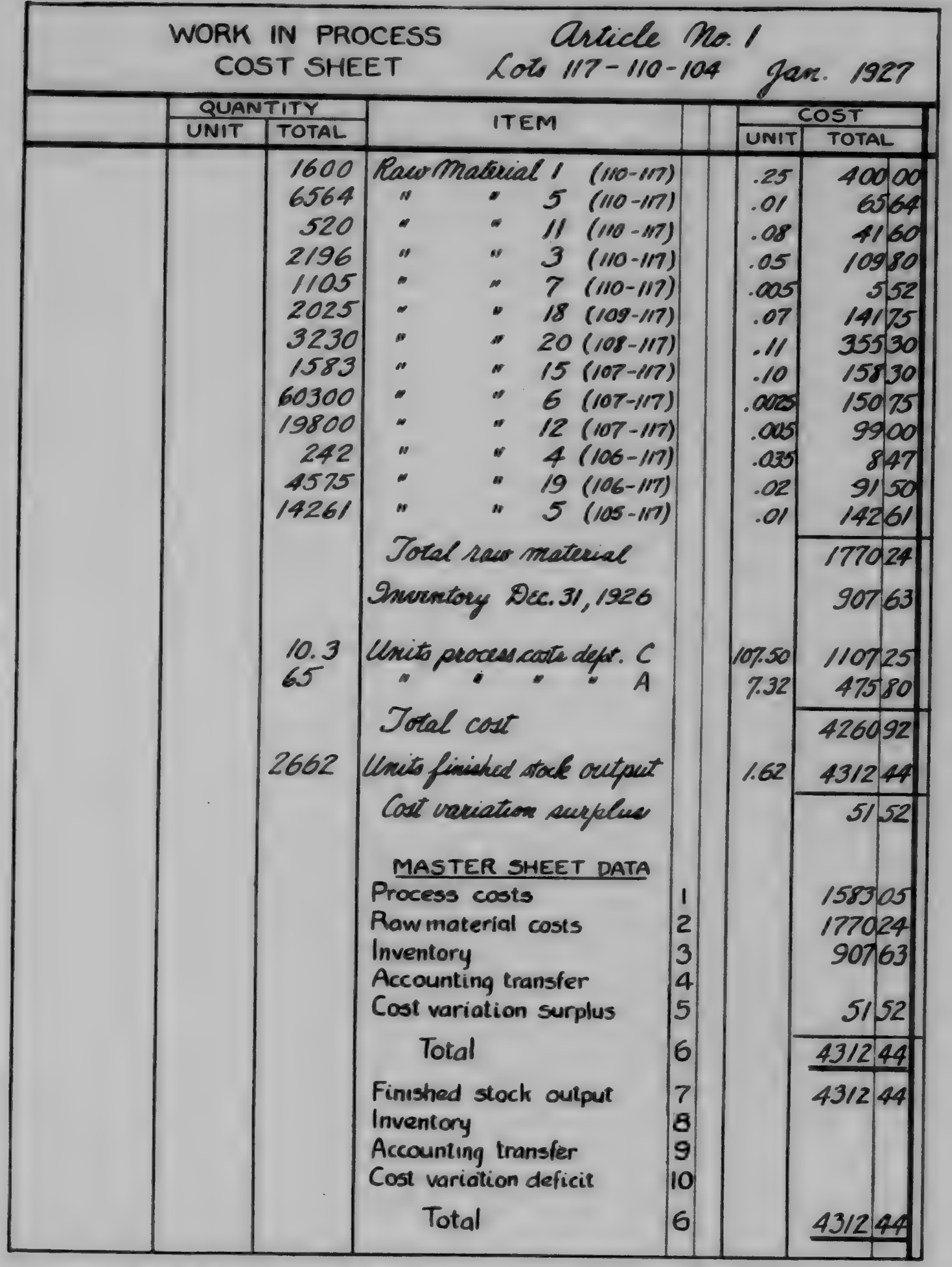
Effect of the Accounting Period.

Unfortunately, the indispensible fiscal periods of accounting often cut off the records before the work on an ordered lot of goods is complete. This time interval interference makes it necessary to conduct two sets of work-in-process cost sheets: one is needed to harmonize with the accounting period and the other to give the complete cost story. Article costs are secured by combining fragmentary sheets and deleting the inventory items.

Setting Up the Operator's Story as a Cost.

The work-in-process cost sheets set up the operator's story as an article cost. Although his data are accepted their accuracy must be verified by comparing them with other facts obtained from the general cost-accounting scheme. The material portion is checked by the warehouse records and the process elements are examined in the light of expenditures reported by the general ledger. Men bring to the management the things they believe are wanted, and

if it can be shown to them, in a common-sense way, that their tale does not fit in with the general-accounting landmarks, they usually will make every effort to bring in more accurate statistics.



WORK IN PROCESS COST SHEET Article No. 1 Lots 117-110-104 Jan. 1927

	QUANTITY UNIT	QUANTITY TOTAL	ITEM			COST UNIT	COST TOTAL
		1600	Raw Material 1 (110-117)			.25	400 00
		6564	" " 5 (110-117)			.01	65 64
		520	" " 11 (110-117)			.08	41 60
		2196	" " 3 (110-117)			.05	109 80
		1105	" " 7 (110-117)			.005	5 52
		2025	" " 18 (109-117)			.07	141 75
		3230	" " 20 (108-117)			.11	355 30
		1583	" " 15 (107-117)			.10	158 30
		60300	" " 6 (107-117)			.0025	150 75
		19800	" " 12 (107-117)			.005	99 00
		242	" " 4 (106-117)			.035	8 47
		4575	" " 19 (106-117)			.02	91 50
		14261	" " 5 (105-117)			.01	142 61
			Total raw material				1770 24
			Inventory Dec. 31, 1926				907 63
		10.3	Units process costs dept. C			107.50	1107 25
		65	" " " " A			7.32	475 80
			Total cost				4260 92
		2662	Units finished stock output			1.62	4312 44
			Cost variation surplus				51 52
			MASTER SHEET DATA				
			Process costs	1			1583 05
			Raw material costs	2			1770 24
			Inventory	3			907 63
			Accounting transfer	4			
			Cost variation surplus	5			51 52
			Total	6			4312 44
			Finished stock output	7			4312 44
			Inventory	8			
			Accounting transfer	9			
			Cost variation deficit	10			
			Total	6			4312 44

FIG. 29.—Work-in-process cost sheet, Article No. 1. The details of the cost standard used in this calculation are given in Fig. 30.

The Work-in-process Cost Sheet.

Figure 29 shows a serviceable work-in-process cost sheet. If the important headings are printed, the sheets, after being filled out, will present a uniform appearace. The sources of the various entries will now be discussed.

Raw-material Entries.

In the preceding chapter it has been shown how the material used for each article can be taken direct from a standard bill of materials, or from a tabulation sheet such as Fig. 24. Whatever the source, the quantities are first priced and extended on the work-in-process cost sheet. This practice permits the calculations to follow the factory operations and makes it possible to report results at the earliest possible moment. Work-in-process cost sheets easily can be tied in with the general-accounting scheme at the end of a period. In this way, the two parts of the clerical work are each performed at the most logical time.

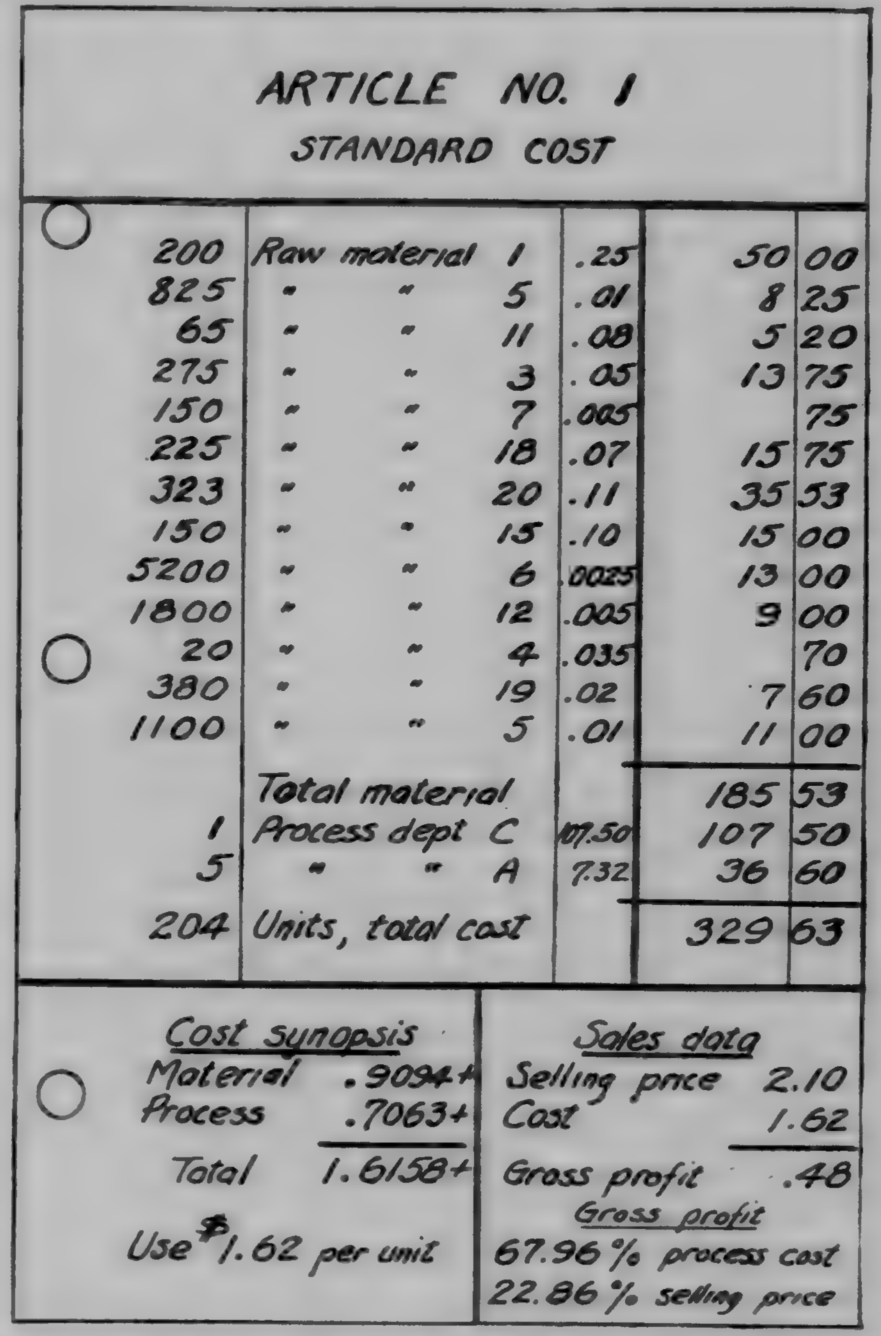
Process-cost Entries.

Properly tabulated progress reports make an excellent source for process charges to the cost sheets. As with the raw-material entries, process values first should be entered on Fig. 29 and subsequently posted to the process ledger (Fig. 17) where all detailed analytical comparisons with the departmental cost elements are made. The work-in-process cost sheets show only the number of units, standard rate, and extension for each process involved in the particular manufacture under consideration.

Inventory and Other Entries.

When a work-in-process cost sheet is cut off by the fiscal period, its values are footed up as an inventory after all output has been deducted at standard cost. The same amount must be entered on a fresh sheet for the calculations of the following month.

Accounting transfers are needed occasionally to clear unusual transactions, such as reprocessing of finished stock, which is returned to the factory from the warehouse because the goods are defective, or for costing saleable byproducts (see p. 149).



ARTICLE NO. 1
STANDARD COST

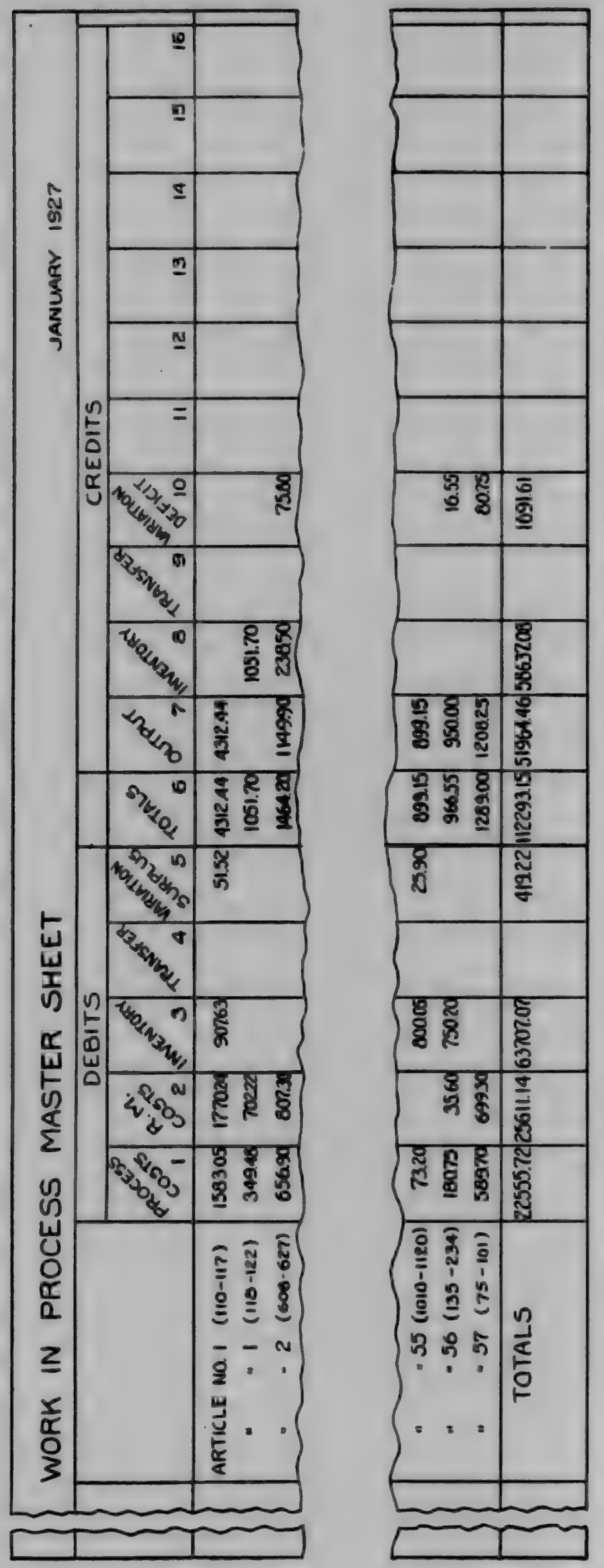
200	Raw material	1	.25	50	00
825	" "	5	.01	8	25
65	" "	11	.08	5	20
275	" "	3	.05	13	75
150	" "	7	.005		75
225	" "	18	.07	15	75
323	" "	20	.11	35	53
150	" "	15	.10	15	00
5200	" "	6	.0025	13	00
1800	" "	12	.005	9	00
20	" "	4	.035		70
380	" "	19	.02	7	60
1100	" "	5	.01	11	00
	Total material			185	53
1	Process dept	C	107.50	107	50
5	" "	A	7.32	36	60
204	Units, total cost			329	63

Cost synopsis		Sales data	
Material	.9094+	Selling price	2.10
Process	.7063+	Cost	1.62
Total	1.6158+	Gross profit	.48
Use $1.62 per unit		Gross profit	
		67.96 % process cost	
		22.86 % selling price	

Fig. 30.—Cost standard, Article No. 1. The details of the cost standard used in Fig. 29 are given here.

Output Entries.

Output records can be kept on the tabulation of raw material consumed (Fig. 24). The quantities must be checked with the warehouse receipts after proper contacts for each production order have been made. At times a supporting analytical record is needed to verify the grades of



WORK IN PROCESS MASTER SHEET JANUARY 1927

	DEBITS						CREDITS									
	PROCESS COSTS 1	R.M. COSTS 2	INVENTORY 3	TRANSFER 4	VARIATION SURPLUS 5	TOTALS 6	OUTPUT 7	INVENTORY 8	TRANSFER 9	VARIATION DEFICIT 10	11	12	13	14	15	16
ARTICLE NO. 1 (110-117)	1583.05	1770.24	907.63		51.52	4312.44	4312.44									
" " 1 (118-122)	349.48	702.22				1051.70		1051.70								
" " 2 (606-627)	656.90	807.30				1464.20	1149.90	238.50		75.00						
" " 55 (1010-1120)	73.20		800.05		25.90	899.15	899.15									
" " 56 (135-234)	180.75	35.60	750.20			966.55	950.00			16.55						
" " 57 (75-101)	589.70	699.30				1289.00	1208.25			80.75						
TOTALS	22555.72	25611.14	63707.07		419.22	112293.15	51964.46	58637.08		1691.61						

Fig. 31.—Work-in-process master sheet. The form of Fig. 4 is again featured here.

stock. The design of a method is entirely a local problem. The accepted output is extended at standard cost and after the order is complete the resulting difference on the work-in-process cost sheet is written off as a surplus or deficit cost variation. The handling of class and joint products is discussed on page 149.

The Master Sheet.

As with the raw-material ledger, a master sheet is necessary to get the entries for the controlling accounts. It will be found convenient to summarize the values at the bottom of the cost sheet and to number the items to correspond with the columns of the master sheet. Figure 31 illustrates the procedure.

Article Cost Sheets.

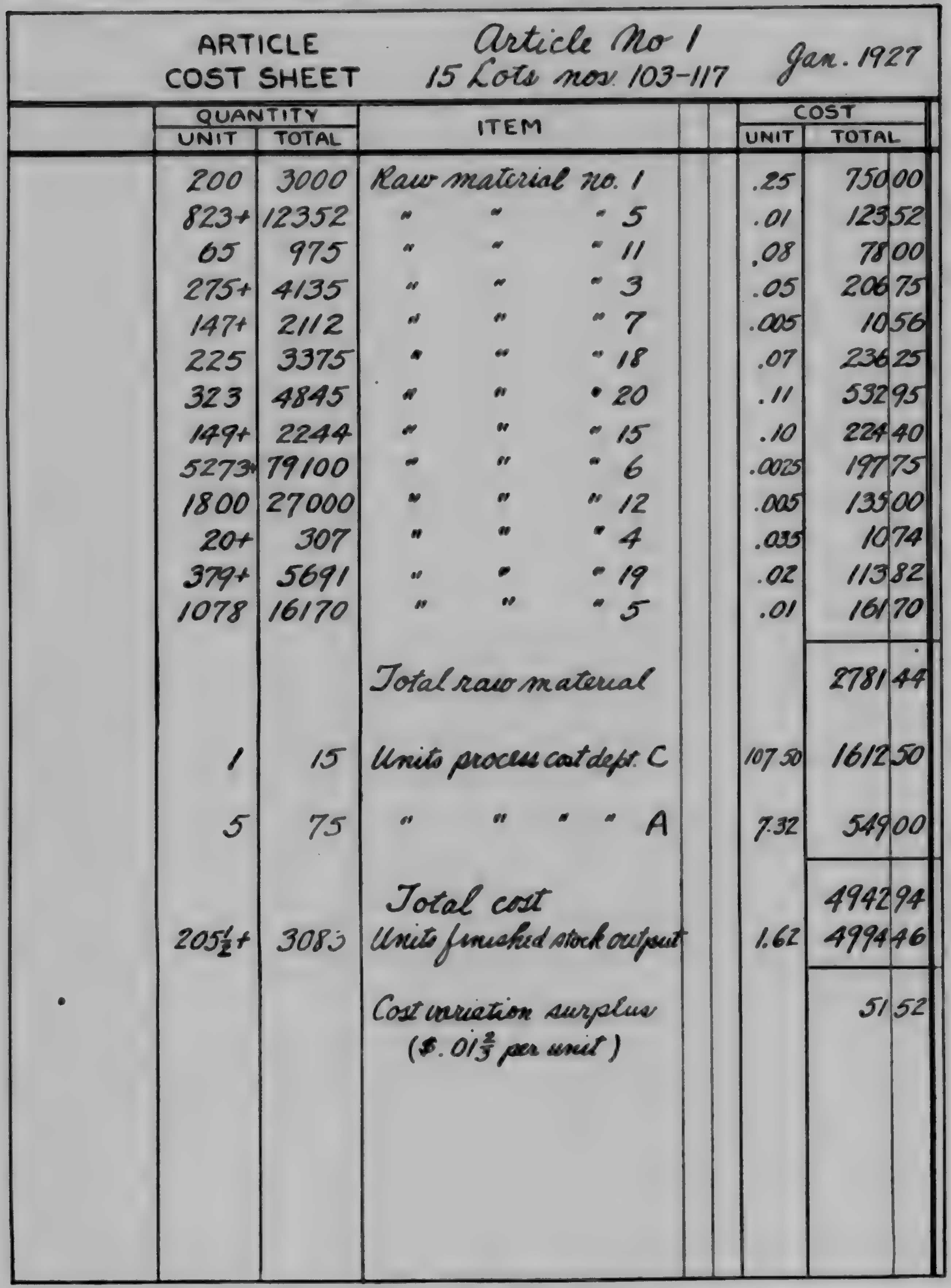
Figure 32 illustrates an article cost sheet obtained by supplanting the inventory item on the work-in-process cost sheet (Fig. 29).

Establish Article Costs at Frequent Intervals.

Article costs should be taken at short intervals. To let them run for a long time causes many essential facts to become faded and allows cost variations to pile up in the inventories until they no longer reflect the true situation. Work-in-process cost finding should go on all the time, regardless of the fiscal periods if the costs on a production order are to be available at the completion of the work. This practice does not interfere with the operation of any other part of the system and, in fact, simplifies it, for then much of the clerical work is finished when the extra burden of the accounting period is met.

Class and Joint Products.

To secure manufacturing economies a group of dissimilar objects are often processed together. When such operations as drying, baking, electroplating, casting, etc., are



ARTICLE COST SHEET — Article No 1 — 15 Lots nos 103-117 — Jan. 1927

	QUANTITY		ITEM			COST		
	UNIT	TOTAL				UNIT	TOTAL	
	200	3000	Raw material no. 1			.25	750	00
	823+	12352	" " " 5			.01	123	52
	65	975	" " " 11			.08	78	00
	275+	4135	" " " 3			.05	206	75
	147+	2112	" " " 7			.005	10	56
	225	3375	" " " 18			.07	236	25
	323	4845	" " " 20			.11	532	95
	149+	2244	" " " 15			.10	224	40
	5273+	79100	" " " 6			.0025	197	75
	1800	27000	" " " 12			.005	135	00
	20+	307	" " " 4			.035	10	74
	379+	5691	" " " 19			.02	113	82
	1078	16170	" " " 5			.01	161	70
			Total raw material				2781	44
	1	15	Units process cost dept. C			107.50	1612	50
	5	75	" " " " A			7.32	549	00
			Total cost				4942	94
	205½+	3083	Units finished stock output			1.62	4994	46
			Cost variation surplus ($.01⅔ per unit)				51	52

FIG. 32.—Article cost sheet, Article No. 1.

applied to a group of unrelated articles, we obtain class costs which must be distributed to the individual members in direct proportion to some unit of measurement based on a weight, a volume, an area, etc. The calculations may involve both materials and processes or either of them alone. The correct units for computing the process costs are not always the most convenient ones to use. For instance, the tendency with drying operations is to figure the cost per unit of material dried when the real charge should be per unit of moisture driven off (see p. 108).

The distribution of joint costs is an onerous problem. No longer are we able to select, as members of a group, things we can sell; but we must accept, without regard for their marketability, the articles which the natural laws of the processes being used permit us to have as members of the group. If, in the face of these conditions we distribute joint costs on a basis of weight, volume, etc., we are almost certain to find that some articles must be sold at a loss. For this reason, we feel inclined to disregard allocations which recognize the exact amount of manufacturing cost created by each item of finished stock and, instead, our thoughts turn towards empirical distributions based on the market value of each article. An examination of two positions in the gamut of industrial possibilities will help us to understand the average case of joint products.

In the one case, only the major product A enjoys a profitable market. The byproducts X, Y, and Z are saleable wastes; yet competition ultimately forces us to consider the income they produce as an offset to the cost of manufacturing the major article A. The accounting procedure is quite simple. Operating experience gradually fixes the quantities of X, Y, and Z recovered from each lot of A produced, together with the cost of putting them into a marketable condition. Knowing the selling prices of X, Y, and Z, we can credit the work-in-process cost sheet for the parent manufacture A, as an accounting transfer, with the expected quantities of these byproducts extended at their separate unfinished values. A new work-in-process cost sheet is opened for each byproduct. Each value so transferred, when it is supplemented by the costs of further processing, handling, packing, etc. should equal the approximate market value of the byproduct less all sales and office expenses. Any profit or loss on the byproducts X, Y, and Z is entirely a matter of incorrect estimates as to the quantity actually recovered, the realizable market value, or the cost of further processing.

In the other case, all of the products enjoy a profitable market. The accounting technique is the same, but the pricing principle is different. The cost burden each article is expected to carry depends entirely on our attitude towards the commercial situation. In the chemical industry, the byproducts of today are the major products of tomorrow. Reversals are sudden and drastic. No policy as to pricing the joint units should be adopted until a thorough market investigation has revealed the true quantitative and qualitative status of each article. Sometimes a byproduct is superior to an article of direct manufacture and again markets can be found only by selling the byproduct at a very low price.

Intermediates, Parts, Component Materials, etc.

In the manufactures we frequently encounter articles which are complete from a production standpoint, although they cannot ordinarily be marketed until they have received further processing or have been assembled into more highly developed units. Costs can be and should be established for these products. Strictly speaking, these things are neither raw materials, work in process, nor finished stock and in different industries they are variously called intermediates, parts, component materials, etc.

The costs of these entities can be controlled by any one of the three major material divisions, but the raw-material account is best suited to the task. The work-in-process total is a significant figure in that it tells us the amount of stock actually being treated in the factory. To distort the value by adding completed parts is hardly wise. Similar reasons make it undesirable to confuse our thoughts as to the quantities of goods on hand ready to ship. The raw-material total is usually not so important as the underlying details and consequently carrying the component material costs there does not greatly affect our perspective of the enterprise. If, in spite of the disadvantage of extending a system of records which, in its simplest terms, must ever tend towards the elaborate, we desire to distinguish component materials in the controlling accounts, then we must add a fourth group to the material classification.

The accounting technique arising through the use of an intermediates', parts', component materials', etc., division easily can be deduced from the data presented for the other three classes. Work-in-process output requiring further processing or assembly is charged to this fourth controlling account until it is requisitioned for further use. In case articles of this category are sold the quantity involved easily can be shifted to the finished stock as an accounting transfer. Parts or intermediates used for further processing are charged and controlled just like raw materials.

People are often tempted to add profits to the standard costs of intermediates, parts, component materials, etc., prior to incorporating them in the costs of more advanced articles. This is a mistake because it violates the accounting principle which says we should not anticipate profits. The amount of earnings to be brought in by intermediate goods can be fixed when the gross profit on saleable articles is set. W. L. Churchill in "On What Should Profits Be Based?" *Industrial Management*, November, 1919, and in his subsequent writings, which also can be consulted advantageously, has brought out some valuable suggestions as to correct principles for determining profits.

CHAPTER XII

FINISHED-STOCK COSTS

Design of a Finished-stock Ledger.

Figure 26 can also be used for a finished-stock ledger. Appropriate debit and credit entries are given on Fig. 33. Just as in the case of raw materials, all the finished-stock transactions can be handled through relatively few standardized charges.

Sales Data.

In order to eliminate a supplementary record, the sales statistics on individual articles should be placed on the finished-stock ledger sheets. By stating the gross sales, the sales credits, the net sales, and the cost of goods sold, we arrive at the gross profit or deficit. To ascertain the sales of each article it is necessary to analyse the general sales book at the end of the month. If the volume of transactions is not too large this can be done conveniently by posting the sales monthly to sheets like Fig. 26. A separate page is required for each article and a separate line for each customer. The apt presentation of market data makes the record of value to the sales department, apart from its accounting use. The Cost of Goods Sold, item 3, is established by subtracting item 8, Returned Goods, from item 12, Sales at Cost. To complete the sales data, the gross profit is calculated as a percentage of net sales.

Inventory Entries.

As with the raw-material inventories, those for finished stock are always book balances. When the stock gets

FINISHED STOCK LEDGER

		JANUARY				FEBRUA		
		QUANTITY	PRICE	AMOUNT		QUANTITY	PRICE	A
SALES DATA								
Sales	1	3000	2.10	6300	00			
" credits	2							
Net sales								
Cost of goods sold	3	3000	1.62	4860	00			
Deficit	4							
Gross profit	5			1440	00			
" " % of sales		22.8%						
DEBITS								
Inventory, initial	6	2020	1.62	3272	40			
Work in process finished	7	2662	1.62	4312	44			
" " " "	7							
" " " "	7							
Returned goods	8							
Accounting transfer	9							
Surplus, errors	10							
" price adjust.	10							
Totals	11	4682		7584	84			
CREDITS								
Sales at cost	12	3000	1.62	4860	00			
" " "	12							
Used, not sold	13	10	1.62	16	20			
Accounting transfer	14							
Deficit, errors	15	3	1.62	4	86			
" price adjust.	15							
Inventory, final	16	1669	1.62	2703	78			
Totals	11	4682		7584	84			

FIG. 33.—Finished-stock ledger. A portion of Fig. 26 is shown here to illustrate its use as a finished-stock ledger sheet, for Article No. 1.

low, a physical count can be taken to ascertain the amount to be written off as a positive or negative cost variation.

Work in Process Finished.

Entry 7 showing the output of finished goods is obtained from the work-in-process cost sheets and not from the article cost sheets. It reduces the clerical labor at the fiscal period to post the output from each work-in-process cost sheet to the finished-stock ledger as soon as the facts are available.

Returned Goods.

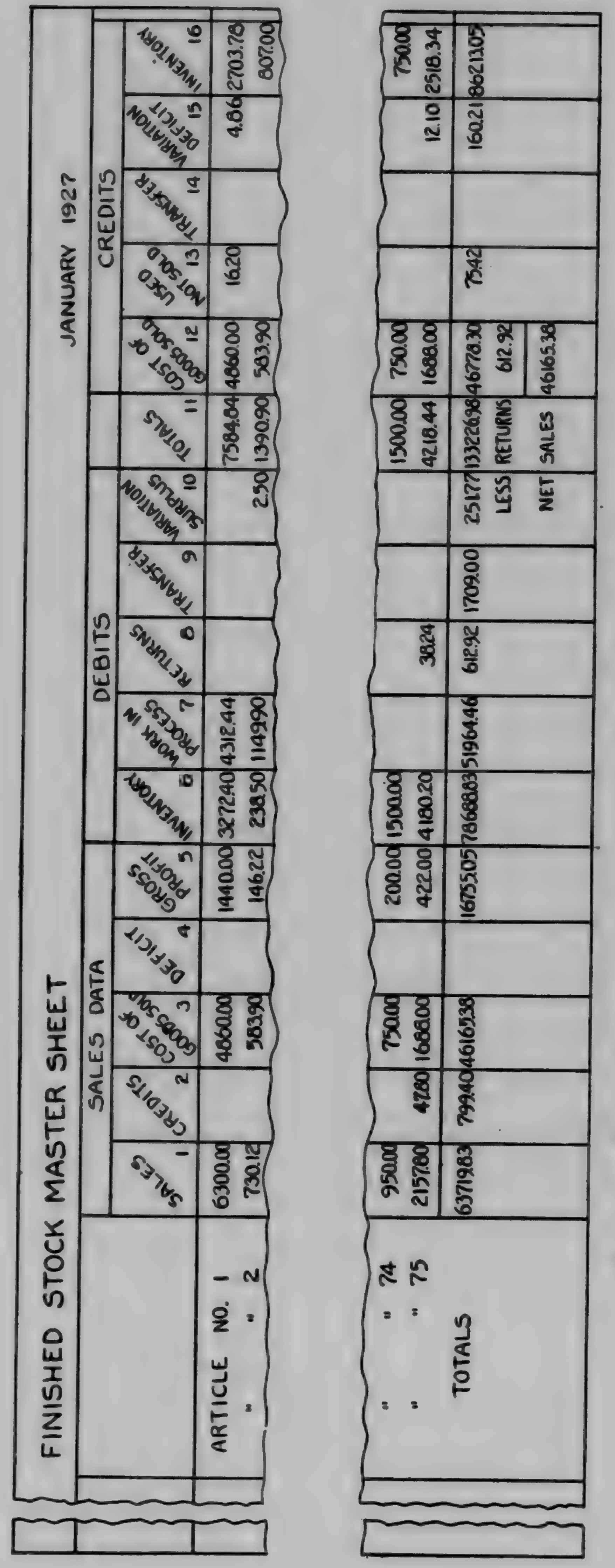
Accounting for returned goods can proceed in two ways. The values can be deducted from the sales of the month so as to show only net sales, or they can be set up so as to show both net and gross sales. This last method is the best because it presents figures which should never be merged with other values. When returns are too high, something is wrong and the management should be informed of it so that corrective action can be taken. Returns can be priced at current inventory values. Allowances involve no movements of goods and hence are not shown in the finished-stock ledger proper, although they appear under item 2, Sales Credits.

Accounting Transfer.

Accounting Transfer, items 9 and 14, offer convenient bookkeeping channels for shifting raw materials which are regularly sold to the finished-stock ledger, for charging goods back to work in process when they must be reprocessed and for other material shifts which, from time to time, become necessary.

Cost Variations.

In a well-handled plant, discrepancies in finished stock should be almost negligible. By keeping a record of them on the ledger they are certain to be kept within proper



FINISHED STOCK MASTER SHEET JANUARY 1927

	SALES DATA					DEBITS						CREDITS				
	SALES 1	CREDITS 2	COST OF GOODS SOLD 3	DEFICIT 4	GROSS PROFIT 5	INVENTORY 6	WORK IN PROCESS 7	RETURNS 8	TRANSFER 9	VARIATION SURPLUS 10	TOTALS 11	COST OF GOODS SOLD 12	USED NOT SOLD 13	TRANSFER 14	VARIATION DEFICIT 15	INVENTORY 16
ARTICLE NO. 1	6300.00		4860.00		1440.00	3272.40	4312.44				7584.84	4860.00	16.20		4.86	2703.78
" " 2	730.12		583.90		146.22	238.50	1149.90			2.50	1390.90	583.90				807.00
" " 74	950.00		750.00		200.00	1500.00					1500.00	750.00				750.00
" " 75	2157.80	47.80	1688.00		422.00	4180.20		38.24			4218.44	1688.00			12.10	2518.34
TOTALS	63719.83	799.40	46165.38		16755.05	78688.83	51964.46	612.92	1709.00	251.77	133226.98	46778.30	75.42		160.21	86213.05
										LESS	RETURNS	612.92				
										NET	SALES	46165.38				

Fig 34.—Finished-stock master sheet. The form of Fig. 4 is again featured here.

limits. One line under surplus and under deficit explains all losses, and another line permits marking up or writing down the value of goods on hand.

Cost of Goods Sold.

Sales of finished stock always should be entered in gross amount. The reason for this was explained in the article on returned goods. The quantity of each article, product, or class of goods sold is obtained from an analysis of the sales book as given on page 152.

Finished Stock Used, Not Sold.

Small quantities of finished stock are often used in non-productive ways. Item 13 makes it possible to show the stock given away to customers as samples, the amounts used by the technical department in tests, etc.

The Master Sheet.

The finished-stock ledger must also be summarized by means of a master sheet. The items on Fig. 33 are coded to correspond to the columns on Fig. 34. As before, the column footings give the desired controlling cost entries. The use to which they are put and the relationships between the various master sheets will be explained in Chap. XIII.

PART IV

THE RESULTS

CHAPTER XIII

ENTERING COSTS ON THE GENERAL BOOKS

Costs and the General Ledger.

Cost accounting is essentially the progeny of engineering thought. Many accountants have studied the subject, yet little mention has been made of the wonderful possibilities dormant in a thorough union of costs with the facts of ordinary commercial accounting. Bookkeeping shows receipts and expenditures, but with the internal shifting of values it is, in general, unable to cope. As the cost accounts are in a position to close this gap in bookkeeping values, by uniting the two themes, we come into possession of an unexcelled narrative which depicts all of the causes underlying changes in the finances of a business.

The Factory-cost Journal.

Good accounting practice requires us to compress costs into the fewest possible entries for the general ledger. As this can easily be done in one of the modern specially ruled journals, it is necessary only to determine how many columns are required for the purpose. An examination of the cost data shows that the charges can be divided into six groups, and, consequently, a twelve-column journal will answer. A debit and a credit column is required for each of the following:

1. Raw-material entries.
2. Work-in-process entries.
3. Component-material entries.
4. Finished-stock entries.
5. Cost-variation entries.
6. Entries to all other accounts.

COST JOURNAL

	COST VARIATION	FINISHED STOCK	COMPONENT MATERIAL	WORK IN PROCESS	RAW MATERIAL	GENERAL LEDGER	DR	ACCOUNTS	CR	GENERAL LEDGER	RAW MATERIAL	WORK IN PROCESS	COMPONENT MATERIAL	FINISHED STOCK	COST VARIATION
								Table VI							
								DEPT. COST ELEMENTS							
								Depreciation Buildings	15	757 35					
								Depreciation Plant	16	3 185 02					
								Taxes	67	720 00					
								Fire Insurance	26	812 50					
								Administrative Expense	3	956 25					
								Advertising	4	1 190 00					
								Miscellaneous Insurance	27	487 42					
								Mechanical Expense	36	75 33					
								Office Expense	42	124 60					
								Repairs	54	250 00					
								Selling Expense	64	586 82					
								Technical Expense	68	175 11					
								Transportation Outbound	70	248 79					
								Factory Supplies	19	288 90					
								Metered Supplies	37	552 29					
								Packing Supplies	43	760 02					
								Raw Material			37 98				
								Finished Stock						75 42	
								Fuel	23	634 43					
								Pay Roll	45	16 296 17					
								Salaries	58	3 966 67					
								Fig. 6							
								DEPARTMENTAL COSTS							
						21 736 44	47	Process Costs							
						8 879 98	25	General Overhead							
						859 00	38	New Construction							
						203 50	53	Renewal of Plant							
						71 50	65	Spare Parts							
						15 60	23	Fuel							
					155 60			Raw Material							
						400 50	44	Patents Formulae Design							
								Cost Variation Surplus							141 05
					155 60	32 166 52		32 322.12		32 067 67	37 98			75 42	141 05
								Totals Forward							

FIG. 35.—Cost journal, sheet 1. The complete cost journal entries are given in Figs. 35 and 36.

COST JOURNAL

	COST VARIATION	FINISHED STOCK	COMPONENT MATERIAL	WORK IN PROCESS	RAW MATERIAL	GENERAL LEDGER	DR	ACCOUNTS	CR	GENERAL LEDGER	RAW MATERIAL	WORK IN PROCESS	COMPONENT MATERIAL	FINISHED STOCK	COST VARIATION
					155 60	32 166 52		Brought Forward		32 067 67	37 98			75 42	141 05
								Fig. 18 PROCESS COST							
								MASTER SHEET							
				22 555 72				Work in Process							
								Cost Variation Surplus							819 28
								Process Costs	47	21 736 44					
								Fig. 28 RAW MATERIAL							
								MASTER SHEET							
					25 875 90			R.M. Purchase Invoices	50	25 875 90					
					175 80			Received Without Invoice	35	175 80					
					201 19			In Transit	34	201 19					
					350 65			Cost Variation Surplus							350 65
				25 611 14				Work in Process			25 611 14				
						1 755 90	13	Raw Material Sold			1 755 90				
						88 50	51	Purchase Credits			88 50				
						58 95	35	Received Without Invoice			58 95				
						295 80	34	In Transit			295 80				
		1 709 00						Accounting Transfer			1 709 00				
	692 50							Cost Variation Deficit			692 50				
								Fig. 31 WORK IN PROCESS							
								MASTER SHEET							
				419 22				Cost Variation Surplus							419 22
	1 691 61							Cost Variation Deficit				1 691 61			
								Fig. 34 FINISHED STOCK							
								MASTER SHEET							
		51 964 46						Work in Process				51 964 46			
		612 92						Cost of Goods Returned	12	612 92					
		251 77						Cost Variation Surplus							251 77
						46 778 30	12	Cost of Goods Sold						46 778 30	
	160 21							Cost Variation Deficit						160 21	
	2 544 32	54 538 15		48 586 08	26 759 14	81 143 97		219,571.66		80 669 92	30 249 77	53 696 07		47 013 33	1 981 97
								← Totals →							
		78 688 83		63 707 07	33 676 37			Inventories			30 185 74	58 637 08		86 213 05	
		133 226 98		112 293 15	60 435 51			Master Sheet Totals			60 435 51	112 293 15		133 226 98	

FIG. 36.—Cost journal, sheet 2. The complete cost journal entries are given in Figs. 35 and 36.

The entire factory costs have been set up on seven different records, each one of which must be journalized. The component-material account, similar to the raw-material and finished-stock accounts, has not been developed in the problem, so only six are discussed in the text. The cost-journal entries are obtained from:

1. Tabulation of departmental cost elements (Table VI).
2. Departmental-cost distribution sheet (Fig. 6).
3. Process-cost master sheet (Fig. 18).
4. Raw-material master sheet (Fig. 28).
5. Work-in-process master sheet (Fig. 31).
6. Component-material master sheet (not used here).
7. Finished-stock master sheet (Fig. 34).

Although the divided column journal is well-known it is desirable to review its operation at this point. Figures 35 and 36 illustrate the journal sheet and give the detailed entries. All of the values in the general-ledger column are posted separately, but the figures in the other five columns are footed to get block entries. This summarization eliminates many figures which are meaningless in the general ledger and only serve to clutter up its pages.

Journalizing Departmental Cost Elements.

The elements of departmental costs have been set up on the tabulation sheet (Table VI) and each account in the general ledger now must be credited for its contribution to the total cost. Journalization of the tabulation consists of listing in the general-ledger column, on the credit side of Fig. 35, the amounts originally calculated and used for costs. Values of raw material and finished stock used non-productively as an expense are not placed in the general-ledger column, but are respectively entered in the raw-material and finished-stock columns on the credit side.

The total of the elements need not be debited to a separate ledger account as it can be immediately expressed in terms of the results of the departmental cost distribution. Consequently, the total of the cost tabulation sheet is dropped from the journalization as a debit and the total of the cost distribution sheet is correspondingly dropped as a credit.

Journalizing Departmental Costs.

Journalizing the departmental costs is merely a matter of taking the values from column 16 (Fig. 6) and debiting them to the respective accounts in the general-ledger column. For added facilities, however, the separate values in column 15 of the distribution sheet must be used. The raw-material and cost-variation charges are entered in their own collective posting columns.

Journalizing Process Costs.

The journal entries for process costs are secured from the master sheet (Fig. 18). The standard amount charged to work in process is debited to that account in its own column and the actual process cost is credited to process costs in the general-ledger column. The difference between the two entries is debited or credited, as the case may be, to cost variation in the variation column.

Journalizing Raw-material Costs.

The raw-material journal entries are obtained from the column footings of the master sheet (Fig. 28). The procedure at this point may seem confusing as it appears to be different, although analysis shows it to be identical. Before, two records were equated to get debit and credit entries, but now each figure by itself must furnish the two postings. For example, Raw Material Purchase Invoices is credited $25,875.90 in the general-ledger account column and debited in the raw-material column on the same horizontal line. This method is used for the remaining footings on the master sheet, carefully watching each entry to avoid duplications. Raw material used non-productively, the first of these repetitions, is omitted, as it has been entered previously through the cost tabulation sheet (Table VI). After a little practice, the few similar entries will become well known and cease to be annoying. The inventories, of course, are not journalized.

Journalizing Work-in-process Costs.

The work-in-process master sheet is a connecting link between the raw-material and finished-stock master sheets. The journal debits to work in process have all been made by the raw-material master sheet, and all the credits to work in process will be made by the finished-stock master sheet. From this it becomes apparent that the only facts on the work-in-process master sheet which can be journalized are the cost variations. Figure 36 shows how this is done.

Journalizing Finished-stock Costs.

The journalization of finished-stock costs from the master sheet proceeds in the same fashion as the raw-material costs. Duplications must be avoided, finished stock used, not sold is omitted as it has been entered previously through the cost tabulation sheet (Table VI).

The Complete Journal Entries for Factory Costs.

If the work has been done correctly, a horizontal addition will show the total debits to be equal to the total credits. As a further proof, the material inventories can be added to obtain the master sheet totals; the old inventories must be debited and the new ones credited. This check is shown on the bottom of Fig. 36.

The journal entries are now ready to be posted to the general ledger. The cost variations, the finished stock, the component materials, the work in process, and the raw material debits and credits are entered as column totals. All of the values, both debits and credits, in the general-ledger account columns must be posted separately. The folio numbers on Figs. 35 and 36 refer to the account numbers in Table XXV and to the accounts given in Chap. III.

Fixed-property Adjustments.

From time to time, changes in fixed asset values must be recorded. These entries should be made when the construction work is concluded, as the facts are then still fresh. Completed installations must be transferred from the New Construction account, and abandoned units must be written off the books, together with the loss incurred. Table XXIV shows the general journal entries for a scrapped plant. Their derivation is explained on page 218

TABLE XXIV.—GENERAL JOURNAL ENTRIES FOR A SCRAPPED PLANT UNIT[1]

46. Plant		$10,987.58
57. Reserve for Depreciation of Plant	$ 7,416.62	
53. Renewal of Plant		563.08
62. Salvage	350.00	
22. Fixed Property for Sale	1,925.00	
32. Liquidation Expense		750.00
48. Profit and Loss	2,609.04	
	$12,300.66	$12,300.66

[1] The detailed calculations are given in Table XXXVII. The account numbers are the same as those used in Chap. III.

Annual Cost Reconciliation Entries.

At the end of the year it will be found that some of the calculated monthly charges, such as depreciation, taxes, etc. differ slightly from the true annual cost. Such discrepancies can be written off as a cost variation through a journal adjustment charge in the general books. Each month, however, all cost work should be performed accurately with accepted values. Errors should be located and corrected instead of being marked off as a cost variation.

The General Ledger after All Journal Entries.

Instruction in accounting is had from handling actual figures and not from reading theory. For this reason, all of the ledger accounts are given here in detail preparatory to taking a trial balance.

TABLE XXV.—GENERAL-LEDGER ACCOUNTS AFTER POSTING COSTS

The numbers prefixed to the ledger accounts agree with the numbers given in Chap. III where a description of each account is given. The accounts corresponding to the numbers omitted have not been used in problem. The values in the "description" columns give the open balances in the various accounts.

1—Accounts Payable

Date	Description	Reference	Amount	Date	Description	Reference	Amount
1927 Jan. 31		Table IV	89.69	1926 Dec. 31	Balance	Table III	32,777.58
31		Table IV	36,008.97	1927 Jan. 31		Table IV	39,161.24
					35,840.16		

2—Accounts Receivable

1926 Dec. 31	Balance	Table III	75,692.01	1927 Jan. 31		Table IV	799.40
1927 Jan. 31		Table IV	62,541.93	31		Table IV	62,033.23
31		Table IV	3,318.81				
	78,720.12						

3—Administrative Expense

1927 Jan. 31		Table IV	956.25	1927 Jan. 31		Fig. 35	956.25

4—Advertising

1927 Jan. 31		Table IV	1,190.00	1927 Jan. 31		Fig. 35	1,190.00

6—Buildings, Structures, etc.

1926 Dec. 31	Balance	Table III	181,766.09				

TABLE XXV.—GENERAL-LEDGER ACCOUNTS AFTER POSTING COSTS.—(*Continued*)

7—Capital Stock

Date	Description	Reference	Amount	Date	Description	Reference	Amount
				1926 Dec. 31	Balance	Table III	500,000.00

8—Cash

1926 Dec. 31	Balance	Table III	40,890.16	1927 Jan. 31		Table IV	55,281.93
1927 Jan. 31		Table IV	61,850.25				
	47,458.48						

9—Cash Discount on Purchases

				1927 Jan. 31		Table IV	365.91

10—Cash Discount on Sales

1927 Jan. 31		Table IV	238.20				

11—Containers Returnable

1926 Dec. 31	Balance	Table III	1,280.00	1927 Jan. 31		Table IV	1,050.00
1927 Jan. 31		Table IV	1,510.00				
	1,740.00						

TABLE XXV.—GENERAL-LEDGER ACCOUNTS AFTER POSTING COSTS.—
(*Continued*)

12—Cost of Goods Sold

Date	Description	Reference	Amount	Date	Description	Reference	Amount
1927 Jan. 31		Fig. 36	46,778.30	1927 Jan. 31		Fig. 36	612.92
	46,165.38						

13—Cost of Miscellaneous Materials Sold

1927 Jan. 31		Fig. 36	1,755.90				

14—Cost Variation

1927 Jan. 31		Fig. 36	2,544.32	1927 Jan. 31		Fig. 36	1,981.97
	562.35						

15—Depreciation Accrued on Buildings, etc.

				1927 Jan. 31		Fig. 35	757.35

16—Depreciation Accrued on Plant

				1927 Jan. 31		Fig. 35	3,185.02

17—Discount to the Trade

1927 Jan. 31		Table IV	1,177.90				

TABLE XXV.—GENERAL-LEDGER ACCOUNTS AFTER POSTING COSTS.—
(*Continued*)

19—Factory Supplies

Date	Description	Reference	Amount	Date	Description	Reference	Amount
1926 Dec. 31	Balance	Table III	2,361.68	1927 Jan. 31		Table IV	1.19
1927 Jan. 31		Table IV	190.70	31		Fig. 35	288.90
	2,262.29						

20—Finished Stock

1926 Dec. 31	Balance	Table III	78,688.83	1927 Jan. 31		Fig. 36	47,013.93
1927 Jan. 31		Fig. 36	54,538.15				
	86,213.05						

22—Fixed Property for Sale

1926 Dec. 31	Balance	Table III	1,872.00				
1927 Jan. 31		Table XXIV	1,925.00				
	3,797.00						

23—Fuel

1926 Dec. 31	Balance	Table III	1,410.15	1927 Jan. 31		Fig. 35	634.43
1927 Jan. 31		Table IV	758.65				
31		Fig. 35	15.60				
	1,549.97						

25—General Overhead

1927 Jan. 31		Fig. 35	8,879.98				

TABLE XXV.—GENERAL-LEDGER ACCOUNTS AFTER POSTING COSTS.—*(Continued)*

26—Insurance Unexpired, Fire

Date	Description	Reference	Amount	Date	Description	Reference	Amount
1926 Dec. 31	Balance	Table III	4,508.27	1927 Jan. 31		Fig. 35	812.50
1927 Jan. 31		Table IV	1,508.94				
	5,204.71						

27—Insurance Unexpired, Miscellaneous

1926 Dec. 31	Balance	Table III	105.11	1927 Jan. 31		Fig. 35	487.42
1927 Jan. 31		Table IV	1,125.30				
	742.99						

29—Interest Received

				1927 Jan. 31		Table IV	55.22

30—Investments

1926 Dec. 31	Balance	Table III	25,000.00				

31—Land

1926 Dec. 31	Balance	Table III	33,491.80				

TABLE XXV.—GENERAL-LEDGER ACCOUNTS AFTER POSTING COSTS.—*(Continued)*

32—Liquidation Expense

Date	Description	Reference	Amount	Date	Description	Reference	Amount
1927 Jan. 31		Table IV	750.00	1927 Jan. 31		Table XXIV	750.00

34—Material in Transit

1926 Dec. 31	Balance	Table III	201.19	1927 Jan. 31		Fig. 36	201.19
1927 Jan. 31		Fig. 36	295.80				
	295.80						

35—Material Received without Invoice

1927 Jan. 31		Fig. 36	58.95	1926 Dec. 31	Balance	Table III	58.95
				1927 Jan. 31		Fig. 36	175.80
					175.80		

36—Mechanical Expense

1927 Jan. 31		Table IV	75.33	1927 Jan. 31		Fig. 35	75.33

37—Metered Supplies

1927 Jan. 31		Table IV	557.53	1926 Dec. 31	Balance	Table III	186.13
				1927 Jan. 31		Fig. 35	552.29
					180.89		

TABLE XXV.—GENERAL-LEDGER ACCOUNTS AFTER POSTING COSTS.—(*Continued*)

38—New Construction

Date	Description	Reference	Amount	Date	Description	Reference	Amount
1926							
Dec. 31	Balance	Table III	5,897.18				
1927							
Jan. 31		Table IV	2,580.72				
31		Fig. 35	859.00				
	9,336.90						

42—Office Expense

1927				1927			
Jan. 31		Table IV	124.60	Jan. 31		Fig. 35	124.60

43—Packing Supplies

1926				1927			
Dec. 31	Balance	Table III	1,489.61	Jan. 31		Fig. 35	760.02
1927							
Jan. 31		Table IV	158.95				
	888.54						

44—Patents, Formulae, Design, etc.

1926							
Dec. 31	Balance	Table III	10,000.00				
1927							
Jan. 31		Fig. 35	400.50				

45—Payroll

1927				1927			
Jan. 31		Table IV	15,672.20	Jan. 31		Fig. 35	16,296.17
					623.97		

TABLE XXV.—GENERAL-LEDGER ACCOUNTS AFTER POSTING COSTS.—(*Continued*)

46—Plant

Date	Description	Reference	Amount	Date	Description	Reference	Amount
1926				1927			
Dec. 31	Balance	Table III	254,801.56	Jan. 31		Table XXIV	10,987.58
	243,813.98						

47—Process Costs

1927				1927			
Jan. 31		Fig. 35	21,736.44	Jan. 31		Fig. 36	21,736.44

48—Profit and Loss

1927							
Jan. 31		Table XXIV	2,609.04				

49—Raw Material

1926				1927			
Dec. 31	Balance	Table III	33,676.37	Jan. 31		Fig. 36	30,249.77
1927							
Jan. 31		Fig. 36	26,759.14				
	30,185.74						

50—Raw-material Purchase Invoices

1927				1927			
Jan. 31		Table IV	25,875.90	Jan. 31		Fig. 36	25,875.90

51—Raw-material Purchase Credits

1927				1927			
Jan. 31		Fig. 36	88.50	Jan. 31		Table IV	88.50

TABLE XXV.—GENERAL-LEDGER ACCOUNTS AFTER POSTING COSTS.—(*Continued*)

52—Renewal of Buildings, etc.

Date	Description	Reference	Amount	Date	Description	Reference	Amount
1926 Dec. 31	Balance	Table III	4,202.77				

53—Renewal of Plant

1926 Dec. 31	Balance	Table III	33,651.03	1927 Jan. 31		Table XXIV	563.08
1927 Jan. 31		Table IV	486.57				
31		Fig. 35	203.50				
	33,778.02						

54—Repairs

1927 Jan. 31		Table IV	250.00	1927 Jan. 31		Fig. 35	250.00

56—Reserve for Depreciation of Buildings

				1926 Dec. 31	Balance	Table III	38,652.71

57—Reserve for Depreciation of Plant

1927 Jan. 31		Table XXIV	7,416.62	1926 Dec. 31	Balance	Table III	101,001.89
					93,585.27		

TABLE XXV.—GENERAL-LEDGER ACCOUNTS AFTER POSTING COSTS.—(*Continued*)

58—Salaries

Date	Description	Reference	Amount	Date	Description	Reference	Amount
1927 Jan. 31		Table IV	3,966.67	1927 Jan. 31		Fig. 35	3,966.67

59—Sales

				1927 Jan. 31		Table IV	63,719.83

60—Sales Credits

1927 Jan. 31		Table IV	799.40				

61—Sales of Miscellaneous Materials

				1927 Jan. 31		Table IV	1,820.60

62—Salvage

1927 Jan. 31		Table XXIV	350.00	1927 Jan. 31		Table IV	350.00

63—Scrap

				1927 Jan. 31		Table IV	98.21

TABLE XXV.—GENERAL-LEDGER ACCOUNTS AFTER POSTING COSTS.—(*Continued*)

64—Selling Expense

Date	Description	Reference	Amount	Date	Description	Reference	Amount
1927 Jan. 31		Table IV	586.82	1927 Jan. 31		Fig. 35	586.82

65—Spare Parts

1926 Dec. 31	Balance	Table III	3,782.59				
1927 Jan. 31		Table IV	51.08				
31		Fig. 35	71.50				
	3,905.17						

66—Surplus

				1926 Dec. 31	Balance	Table III	185,798.21

67—Taxes

				1927 Jan. 31		Fig. 35	720.00

68—Technical Expense

1927 Jan. 31		Table IV	175.11	1927 Jan. 31		Fig. 35	175.11

70—Transportation Outbound

1927 Jan. 31		Table IV	248.79	1927 Jan. 31		Fig. 35	248.79

TABLE XXV.—GENERAL-LEDGER ACCOUNTS AFTER POSTING COSTS.—(*Continued*)

71—Work in Process

Date	Description	Reference	Amount	Date	Description	Reference	Amount
1926 Dec. 31	Balance	Table III	63,707.07	1927 Jan. 31		Fig. 36	53,656.07
1927 Jan. 31		Fig. 36	48,586.08				
	58,637.08						

CHAPTER XIV

MAKING UP STATEMENTS

The Trial Balance.

When we survey the trial balance (Table XXVI) drawn from the general ledger after posting the cost calculations, we realize the great value of returning costs to the commercial books. There are no inventories, no prepaid items, and no accrued charges to be figured. The values on the general ledger are complete, and sorting them out as to assets, liabilities, expenses, and income is all that remains to be done if we want to make up a financial statement.

Financial Statements.

It is not possible to present all of the statistics in one statement, nor is the best result secured by crowding all the information into the two well-known statements, *i.e.*, the balance sheet and the profit-and-loss statement. A better exposition is achieved if we strip these two sheets down to the basic facts and relegate the contributory data to supporting schedules. With this end in view, we arrive at the following financial statements and schedules:

1. Balance sheet.
2. Profit-and-loss statement.
3. Gross profit on sales.
4. Analysis of gross profit.
5. Cost of goods sold.
6. Cost of goods manufactured.
7. Cost of raw material consumed.
8. Departmental cost elements.
9. Departmental costs.

Table XXVI.—Trial Balance for Statements,[1] Jan. 31, 1927

		Dr.	Cr.
1.	Accounts Payable		$ 35,840.16
2.	Accounts Receivable	$ 78,720.12	
6.	Buildings, Structures, etc	181,766.09	
7.	Capital Stock		500,000.00
8.	Cash	47,458.48	
9.	Cash Discount on Purchases		365.91
10.	Cash Discount on Sales	238.20	
11.	Containers Returnable	1,740.00	
12.	Cost of Goods Sold	46,165.38	
13.	Cost of Miscellaneous Materials Sold	1,755.90	
14.	Cost Variation	562.35	
15.	Depreciation Accrued on Bldgs., etc		757.35
16.	Depreciation Accrued on Plant		3,185.02
17.	Discount to the Trade	1,177.90	
19.	Factory Supplies	2,262.29	
20.	Finished Stock	86,213.05	
22.	Fixed Property for Sale	3,797.00	
23.	Fuel	1,549.97	
25.	General Overhead	8,879.98	
26.	Insurance Unexpired, Fire	5,204.71	
27.	Insurance Unexpired, Miscellaneous	742.99	
29.	Interest Received		55.22
30.	Investments	$ 25,000.00	
31.	Land	33,491.80	
34.	Material in Transit	295.80	
35.	Material Received without Invoice		$ 175.80
37.	Metered Supplies		180.89
38.	New Construction	9,336.90	
43.	Packing Supplies	888.54	
44.	Patents, Formulae, Design, etc	10,400.50	
45.	Payroll		623.97
46.	Plant	243,813.98	
48.	Profit and Loss	2,609.04	
49.	Raw Material	30,185.74	
52.	Renewal of Buildings, etc	4,202.77	
53.	Renewal of Plant	33,778.02	
56.	Reserve for Depreciation of Bldgs., etc.		38,652.71
57.	Reserve for Depreciation of Plant		93,585.27
59.	Sales		63,719.83
60.	Sales Credits	799.40	
61.	Sales of Miscellaneous Materials		1,820.60
63.	Scrap		98.21
65.	Spare Parts	3,905.17	
66.	Surplus		185,798.21
67.	Taxes		720.00
71.	Work in Process	58,637.08	
		$925,579.15	$925,579.15

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[1] The account numbers agree with those used in Table XXV and in Chap. III.

TABLE XXVII.—STATEMENT OF ASSETS AND LIABILITIES, JAN. 31, 1927

Assets			
Cash		$ 47,458.48	
Accounts Receivable		78,720.12	
Total Cash and Receivables			$126,178.60
Insurance Unexpired, Fire		5,204.71	
Insurance Unexpired, Miscellaneous		742.99	
Total Prepaid Insurance			5,947.70
Raw Material		30,185.74	
Work in Process		58,637.08	
Finished Stock		86,213.05	
Material in Transit		295.80	
Total Material Inventory			175,331.67
Containers Returnable		1,740.00	
Factory Supplies		2,262.29	
Fixed Property For Sale		3,797.00	
Fuel		1,549.97	
Packing Supplies		888.54	
Spare Parts		3,905.17	
Total Miscellaneous Inventory			14,142.97
Land			33,491.80
Buildings, Structures, etc	$181,766.09		
Renewal of Buildings, etc	4,202.77	$185,968.86	
Reserve for Depreciation	38,652.71		
Accrued Depreciation	757.35	39,410.06	
Net Value Buildings, etc			$146,558.80
Plant	243,813.98		
Renewal of Plant	33,778.02	277,592.00	
Reserve for Depreciation	93,585.27		
Accrued Depreciation	3,185.02	96,770.29	
Net Value of Plant			180,821.71
New Construction			9,336.90
Patents, Formulae, Design, etc			10,400.50
Investments			25,000.00
Total Assets			$727,210.65
Liabilities			
Accounts Payable		$ 35,840.16	
Received without Invoice		175.80	
Metered Supplies		180.89	
Payroll		623.97	
Taxes Accrued		720.00	
Total Payables and Accrued Charges			$ 37,540.82
Capital Stock			500,000.00
Surplus			185,798.21
Profit on January Operations			3,871.62
Total Liabilities			$727,210.65

10. Process costs.
11. Cost-variation summary.

The Balance Sheet.

How to set up a balance sheet has been thoroughly described in the literature and needs no amplification here. This statement of assets and liabilities shows the values owned and owed by a business at a particular moment. The values drawn from the trial balance (Table XXVI) can be arranged conveniently, as shown in Table XXVII.

The Profit-and-loss Statement.

On Table XXVIII the derivation of the gross profit on sales is incorporated with the income and expenses to show the net profit on all operations for January. An income, profit, and loss statement prepared in this way, taken in

TABLE XXVIII.—INCOME, PROFIT, AND LOSS STATEMENT
Jan. 31, 1927

Income from Sales:		
Gross Sales	$63,719.83	
Less Credits	799.40	
Net Sales		$62,920.43
Less Cost of Goods Sold (Schedule A)		46,165.38
Gross Profit on Sales		$16,755.05
Cash Discount on Sales	$ 238.20	
Discount to the Trade	1,177.90	
Less Total Discounts		1,416.10
Net Revenue from Sales		$15,338.95
Other Income:		
Cash Discount on Purchases	$ 365.91	
Interest Received	55.22	
Profit on Miscellaneous Materials Sold	64.70	
Scrap	98.21	
Total Other Income		584.04
		$15,922.99
Expenses:		
Cost Variation (Schedule G)	$ 562.35	
General Overhead (Schedule E)	8,879.98	
Loss on Plant Scrapped	2,609.04	
Total Expenses		12,051.37
Profit on January Operations		$ 3,871.62

conjunction with the balance sheet, exhausts the values given on the trial balance (Table XXVI). To get data for the supporting schedules we must have recourse to the cost records.

Gross-profit Schedules.

Some people prefer a profit and loss statement from which the gross profit calculations have been divorced, and others like to go a step further and analyse the values according to lines, *i.e.*, classes of products. As frequently the greater part of the profit comes from relatively few articles, delving into the origin of the gross profit unfolds the real economic situation. These schedules are very simple and can be easily prepared from the finished-stock master sheet, Fig. 34. They have not been worked out in the text.

Cost of Goods Sold.

Table XXIX, Schedule A, Cost of Goods Sold, presents the totals of the finished-stock master sheet (Fig. 34) in statement form. From it the management can become informed about many key facts without consulting the

TABLE XXIX.—SCHEDULE A—COST OF GOODS SOLD
Jan. 31, 1927

Cost of Goods Manufactured (Schedule B)			$51,964.46
Deduct:			
Inventory Increase:			
Dec. 31, 1926	$78,688.83		
Jan. 31, 1927	86,213.05		
Increase		$7,524.22	
Cost of Finished Stock Used, but Not Sold		75.42	
Total Deductions			7,599.64
After Deductions			$44,364.82
Add:			
Raw Material Sold as Finished Stock		$1,709.00	
Cost-variation Surplus	251.77		
Deficit	160.21		
Net Surplus Cost Variation		91.56	
Total Additions			1,800.56
Cost of Goods Sold			$46,165.38

TABLE XXX.—SCHEDULE B—COST OF GOODS MANUFACTURED
Jan. 31, 1927

Cost of Raw Material Consumed (Schedule C)		$25,611.14	
Process Costs (Schedule F)		22,555.72	
			$48,166.86
Add:			
Inventory Decrease:			
Dec. 31, 1926	$63,707.07		
Jan. 31, 1927	58,637.08		
Decrease			5,069.99
After Additions			53,236.85
Deduct:			
Cost Variation Deficit	$ 1,691.61		
Surplus	419.22		
Net Deficit Cost Variation			1,272.39
Cost of Goods Manufactured			$51,964.46

TABLE XXXI.—SCHEDULE C—COST OF RAW MATERIALS CONSUMED
Jan. 31, 1927

Cost of Raw Material Received:			
January Invoices		$25,875.90	
Received without Invoice during January		175.80	
In Transit, Dec. 31, 1926		201.19	
Warehousing Costs		155.60	
Gross Cost			$26,408.49
Purchase Credits		$ 88.50	
Received without Invoice during December		58.95	
In Transit, Jan. 31, 1927		295.80	
Deductions			443.25
Net Cost of Raw Materials Received			$25,965.24
Add Inventory Decrease:			
Dec. 31, 1926		$33,676.37	
Jan. 31, 1927		30,185.74	
Decrease			3,490.63
Gross Cost of Raw Materials Consumed			$29,454.87
Deduct:			
Cost Variation Deficit	$692.50		
Surplus	350.65		
Net Deficit Cost Variation		$ 341.85	
Raw Material Sold as Finished Stock		1,709.00	
Surplus Raw Material Sold		1,755.90	
Raw Material Used Non-productively		37.98	
Total Deductions			3,843.73
Cost of Raw Material Consumed			$25,611.14

original records. The final value, cost of goods sold, is used on the income, profit, and loss statement (Table XXVIII).

Cost of Goods Manufactured.

Table XXX, Schedule B, Cost of Goods Manufactured, arranges the values on the work-in-process master sheet (Fig. 31) in statement form. The final value, cost of goods manufactured, is used on Schedule A.

Cost of Raw Material Consumed.

Table XXXI, Schedule C, Cost of Raw Material Consumed, draws its figures from the raw-material master sheet (Fig. 28). If a component-material account is used, a similar schedule should be prepared.

TABLE XXXII.—SCHEDULE D—DEPARTMENTAL COST ELEMENTS
Jan. 31, 1927

Depreciation on Buildings, etc.	$ 757.35	
Depreciation on Plant	3,185.02	
Taxes	720.00	
Fire Insurance	812.50	
Fixed Charges		$ 5,474.87
Administrative Expense	956.25	
Advertising	1,190.00	
Miscellaneous Insurance	487.42	
Mechanical Expense	75.33	
Office Expense	124.60	
Repairs	250.00	
Selling Expense	586.82	
Technical Expense	175.11	
Transportation Outbound	248.79	
Expenses		4,094.32
Factory Supplies	288.90	
Metered Supplies	552.29	
Packing Supplies	760.02	
Raw Material Non-productively Used	37.98	
Finished Stock Used, Not Sold	75.42	
Fuel	634.43	
Supplies and Fuel		2,349.04
Payroll	16,296.17	
Salaries	3,966.67	
Payroll and Salaries		20,262.84
Total Departmental Costs		$32,181.07

Departmental Cost Elements.

Table XXXII, Schedule D, Departmental Cost Elements, sets up the non-material cost components previously given in Table VI.

Departmental Costs.

Table XXXIII, Schedule E, Departmental Costs, presents as a statement the results of the distribution sheet (Fig. 6). The totals of Tables XXXII and XXXIII must agree.

TABLE XXXIII.—SCHEDULE E—DEPARTMENTAL COSTS
Jan. 31, 1927

Production Departments:		
Standard Process Costs	$22,555.72	
Net Cost Variation Surplus to Deduct	819.28	
Total		$21,736.44
General Overhead:		
Administrative	2,394.56	
Sales	3,722.55	
Office	1,114.83	
Warehouse	1,648.04	
Total		8,879.98
Added Facilities:		
New Construction	859.00	
Renewal of Plant	203.50	
Spare Parts	71.50	
Fuel, Handling	15.60	
Raw Material, Handling	155.60	
Patents, Formulae, Design, etc.	400.50	
Total		$ 1,705.70
Service Departments:		
Real Estate	$ 2,190.00	
Labor Maintenance	749.03	
Transportation	878.60	
Mechanical	1,319.03	
Power: Steam	1,296.81	
Power: Electric	1,109.68	
Technical	1,652.90	
Supervision	665.14	
Total	9,861.19	
Less Service Costs Distributed	10,002.24	
Less Service Cost Variation Surplus		141.05
Total Departmental Costs (Schedule D)		$32,181.07

Process Costs.

Table XXXIV, Schedule F, gives the values of the process-cost master sheet (Fig. 18), and shows the performance of the various production departments, in addition to the origin of the process cost variation.

TABLE XXXIV.—SCHEDULE F—PROCESS COSTS
Jan. 31, 1927

	Total costs	Cost variation		Process costs
		Deficit	Surplus	
Production Department A.....	$ 7,577.15	$154.59	$ 102.40	$ 7,524.96
Production Department B.....	5,467.86	226.37	592.08	5,833.57
Production Department C.....	4,034.96	18.90	308.11	4,324.17
Production Department D....	4,656.47	32.75	249.30	4,873.02
Totals....................	$21,736.44	$432.61	$1,251.89	$22,555.72
Net cost variation surplus.....	....	....	819.28	

Cost Variation.

Table XXXV, Schedule G, Cost Variation Summary, discloses the separate cost variations which have produced the net result shown on the income, profit, and loss statement.

TABLE XXXV.—SCHEDULE G—COST VARIATION SUMMARY
Jan. 31, 1927

	Cost variations			
	Gross		Net	
	Deficit	Surplus	Deficit	Surplus
Finished stock................	$ 160.21	$ 251.77	....	$ 91.56
Work in process...............	1,691.61	419.22	$1,272.39	
Raw material..................	692.50	350.65	341.85	
Service departments...........	182.53	323.58	....	141.05
Production departments.......	432.61	1,251.89	....	819.28
	$3,159.46	$2,597.11	$1,614.24	$1,051.89
Net deficit variation.........	....	....	562.35	

CHAPTER XV

USING COST VARIATIONS TO CONTROL COSTS

Factory Costs in Perspective.

As we stand back and view the phantasmagoria of factory costs we realize that not for all of it can we claim the full responsibility. Part of it, with a little extra effort, could have been fashioned into a more pleasing result, but some of it is the creation of fortune, acting to our advantage or disadvantage. We cannot change the hand of Providence, but we can dig into costs and find the places where a little weeding and watchfulness will bring to frutition a somewhat more enviable growth.

Cost Control.

There is no better method for controlling costs than that which carefully analyses all departures from a predetermined performance to establish the source of undesirable tendencies. The models must be set with precision and the causes must be diagnosed correctly. On this basis cost control becomes a study of cost variations. What was said earlier in the text can now be restated. Just as a sales organization struggles to win a maximum profit, a factory must fight to put goods in the warehouse with a minimum cost variation. Once we recognize this principle, the problem of cost determination and control can be solved in a simple way.

Origin of Cost Variations.

Figure 37 indicates divers sources of cost variations. Although the causes have been shown separately, they are highly interrelated. For instance, when a raw material of inferior quality is put into process, the lower grade may make itself felt in many directions. It is not unusual to find the yield of finished stock per unit of output reduced, the quantity of labor for processing increased, and the plant output rate lowered. A study of cost variations, therefore, must be directed towards finding the keystone in the arch of causes.

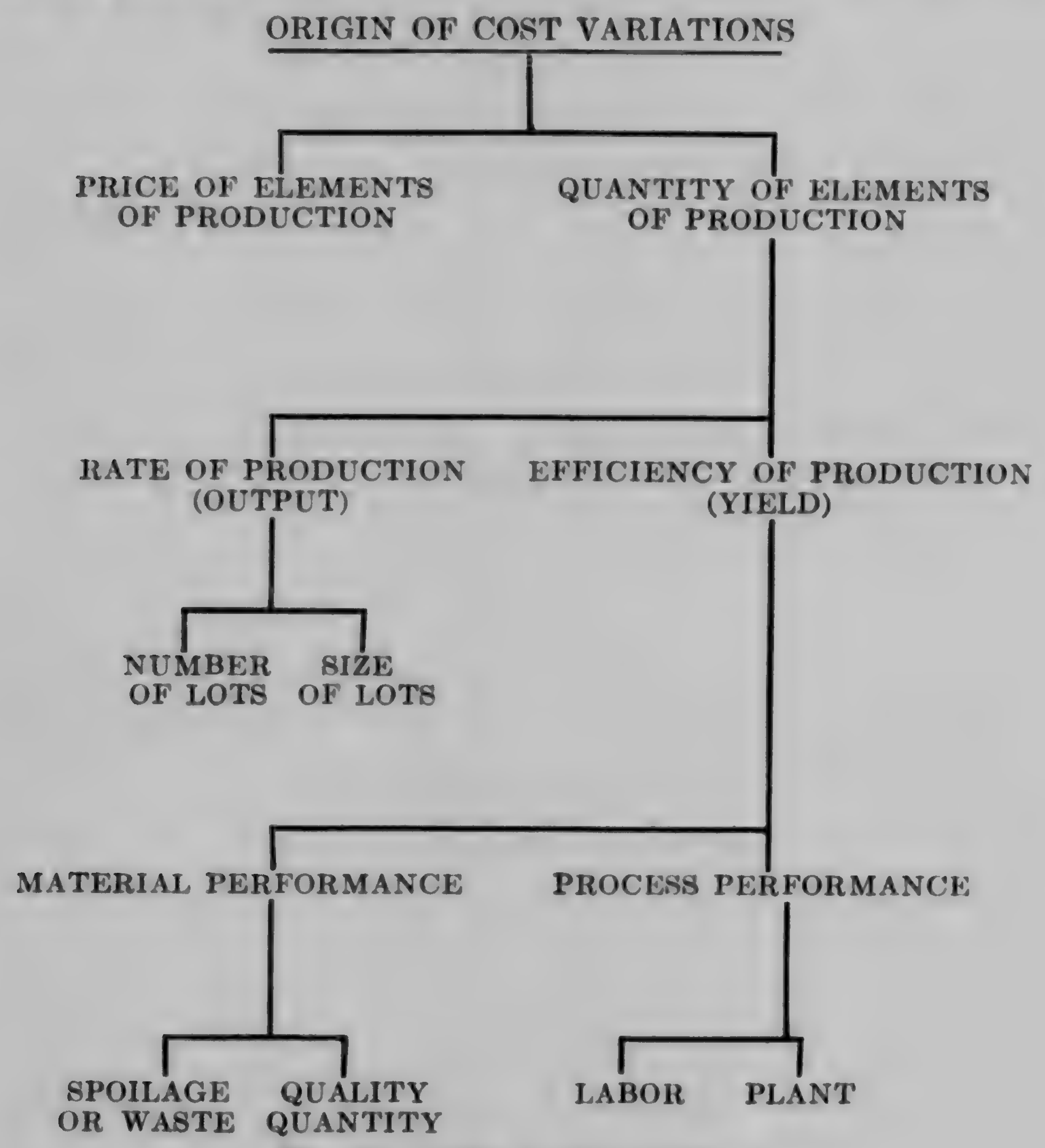

ORIGIN OF COST VARIATIONS
PRICE OF ELEMENTS OF PRODUCTION
QUANTITY OF ELEMENTS OF PRODUCTION
RATE OF PRODUCTION (OUTPUT)
EFFICIENCY OF PRODUCTION (YIELD)
NUMBER OF LOTS
SIZE OF LOTS
MATERIAL PERFORMANCE
PROCESS PERFORMANCE
SPOILAGE OR WASTE
QUALITY QUANTITY
LABOR
PLANT

FIG. 37.—Origin of cost variations.

Cost Variations.

A thorough analysis of cost variations begins with Schedule G, Table XXXV. The net values are of minor interest as both the surplus and deficit quantities must be followed through to their sources. As long as the review is complete, it can be done in any convenient way.

Departmental Cost Elements.

The study of departmental cost elements assumes a budgetary aspect because the actual and not the standard value of the elements is recorded in the accounting scheme. We begin the analysis, therefore, by noting the reasonableness of each element. Comparisons with running averages and with tabulations of past expenditures will do much to anwer any questions arising in the inquiry.

Departmental Costs.

An analysis of departmental costs implies an investigation of past distributions. With the service and production departments, the results can be measured directly in terms of output, but with the other divisions we must fall back on Descartes' method of systematic doubt.

Process Costs.

By first thoroughly searching both the elements and the departmental costs for exceptions we can enter on the process costs with a sure foot. The process master sheet (Fig. 18) and the departmental ledger sheets (Fig. 17) present a detailed analysis of the cost variations, and from these sources much can be learned as to the causes of losses or gains. If the complete departmental-cost calculations are made known to the immediate operating executive, valuable assistance can be obtained from that quarter and fewer explanations will be necessary at subsequent fiscal periods.

Raw-material Costs.

From the cost-variation summary it is an easy step to Schedule C, giving the cost of raw material consumed. Offending raw materials can be quickly located on the master sheet (Fig. 28). The next step is to study the ledger sheet (Fig. 27), the warehouse stock record (Fig. 20 or 21), and the raw-material consumption data (Fig. 25). By this time the reason for the difference will be well known and corrective action can be taken.

Work-in-process Costs.

The importance of work-in-process cost variations varies with different industries. In some manufactures the processing of raw materials proceeds with such smoothness and with so few departures from type that all cost variations are dissipated by the initial standardization of entering quantities and values. In other industries, process performance is so uncertain that the success or failure of an enterprise is decided by this single issue.

The influence of volume of production on work-in-process cost variations is often overlooked. If the output is small and the uncertainties of production are numerous, we greatly increase the risk of having a particular lot turn out to be one of the unfortunate events. In other words, the quantity manufactured must be considered because an average value drawn from a million units is more significant than one drawn from a hundred.

For some unknown reason some manufacturers seem to forget that each unit of unsaleable quality produced reduces the output an equal amount. The cost of turning a factory into an experimental station to retrieve spoiled goods is so enormous that probable quality losses should be incorporated in the performance model.

Work-in-process cost variations are an individual problem. Where they are important they can be quickly traced to their source in the cost sheets by studying the work-in-process master sheet (Fig. 31). When the offending member is located, it is generally necessary to dispatch technical assistance to ascertain the causes.

Finished-stock Costs.

Cost variations in finished stock should be small as the minor losses attending the handling of goods create practically the entire discrepancy. A marked-down inventory is reported through the same channel, but the infrequency of this act makes it stand out in the memory like a mountain in an otherwise unbroken plain. In some industries, goods spoil during storage and through this circumstance cost variations in finished stock are augmented. As with raw materials, the situation can be brought under control by studying the finished-stock master sheet, ledger, and stock records.

A review of finished-stock costs must go on into the sales statistics. The records just mentioned in the preceding paragraph also unfold this information in a most convenient way. If the sales book has been analysed as suggested on page 152, the search can be carried right down to transactions with customers.

CHAPTER XVI

TABULATING COST DATA

Making Cost Data Available for Future Reference.

If we are to get the real benefits accruing from a cost system, we must develop records which will make it possible to review quickly statistics running back over a long period of years. A manufacturing business is a cumbersome, unwieldy organism which resists sudden changes, and to handle such a mechanism it is necessary to study trends carefully and plan changes of direction, rates, etc., well in advance. When the cost records have been summarized effectively for long intervals, a mine of information is available for forming judgments as to proper actions. The tabulation of results is practically as important as cost accounting itself.

Tabulating Important Facts.

The two forms illustrated in Fig. 38 easily can be arranged to accommodate all kinds of cost data. The short sheet makes it possible to refer to the original accounts for an indefinite period without trying to run back over a long horizontal line. Generally, facts should be summarized for yearly intervals, as on a shorter basis the records soon become unwieldy. If it is necessary to get at intermediate data this can be done more easily by consulting the original documents. Some data are analysed best by comparing the monthly figures with a running average extending back over the last twelve months or so.

Departmental Cost Elements.

The departmental cost elements require monthly and yearly comparisons. One record is needed to set up the

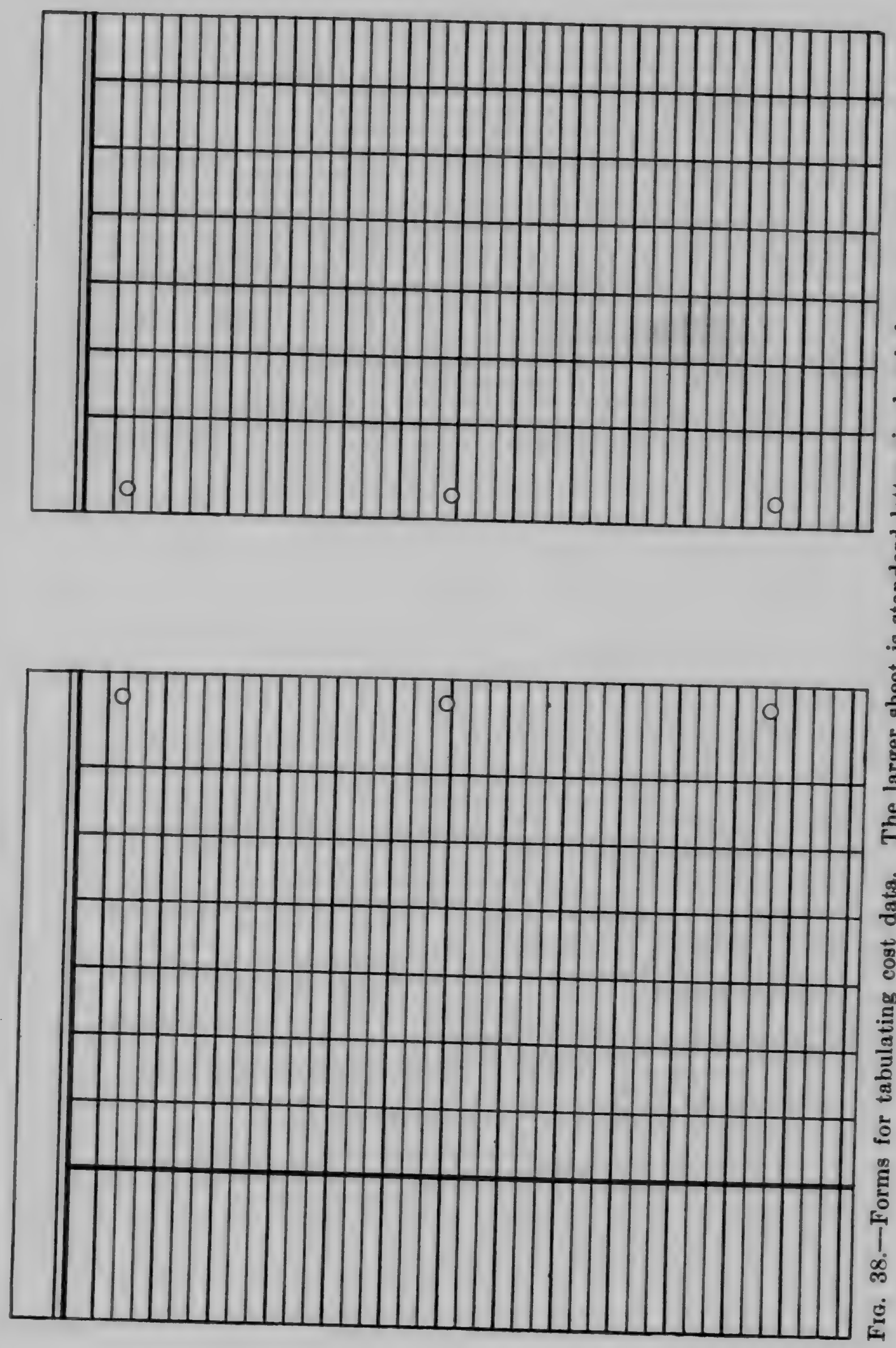


Fig. 38.—Forms for tabulating cost data. The larger sheet is standard letter sized, ruled on one side only, but the shorter sheet is ruled on both sides.

annual value of the separate cost elements given in Table VI. A monthly running average is valuable for intermediate comparisons.

Departmental and Process Costs.

Each department on the departmental-cost distribution sheet should have a separate tabulation record showing its annual operating costs in terms of the column headings. When there is added to this a record of the units produced each year, we are provided with sufficient material to make a careful survey of reasonable cost standards. A tabulation of cost variations is also a most suggestive index to performance.

Raw Material, Work in Process and Finished Stock.

If not all, at least the important raw materials should be summarized annually from the ledger sheets. If the quantities, prices, and amounts are posted for each ledger item, a complete material history is had. Similar records for work in process, component materials, and finished stock are desirable. Purchase prices, quantities, sales data, losses in handling materials, and every other fact pertaining to materials is to be found in such a tabulation when the information is needed.

Other Cost Data.

Many financial facts obtained from the statements can be tabulated to advantage. It may be desirable to put some of these records on a monthly basis. Suggestions will be found in Young's "Statistics as Applied in Business," Gilman's "Analyzing Financial Statements," and Bliss's "Financial and Operating Ratios in Management," all published by The Ronald Press Company, New York, and in Smith's, "Graphic Statistics in Management," McGraw-Hill Book Company, Inc., New York.

PART V

FIXED PROPERTY

CHAPTER XVII

FIXED-PROPERTY ANALYSIS

Why Fixed-property Analysis is Important.

Fixed-property carrying charges enter into factory costs so extensively that the text cannot be brought to a satisfactory conclusion without discussing this vital topic. All attempts to develop a suitable accounting technique for fixed property must be preceded by an analysis of the invested values. Once we are familiar with the details and thoroughly understand their relationships, acceptable accounting methods can easily be devised.

Fixed-property Classifications.

Many of the difficulties in which most schemes for the classification of fixed property become enmeshed arise through the failure to recognize that invested values must be examined from a number of different viewpoints. The following five principles, each one of which dictates a separate, yet interlocking system, will be discussed at length:

1. Type of fixed property.
2. Elements of construction.
3. Location.
4. Departmental ownership.
5. Process use.

Type of Fixed Property.

Naturally, our first thoughts on fixed property follow the main highways—we are interested in valuations, potential marketability, etc. This aspect is that of the controlling accounts in the general ledger. For the major purposes of bookkeeping, the fixed-property values need not be reported in more detail than is given by the four components:

a. Land.
b. Buildings, structures, etc.
c. Plant.
d. Intangibles.

Elements of Construction.

To establish a sound basis for valuations it is necessary to examine the details of construction. The value under consideration here is that of a going concern, because the actual cash worth in the market depends entirely on the preponderance of buyers or sellers and is not the point at issue. Unless we examine the construction in great detail, any set valuation is entirely a matter of guesswork, the accuracy of which is in direct proportion to the experience of the appraiser. The facts pertaining to the construction of fixed property are seldom used and can safely be left in the original erection records or in an appraisal without finical arrangement of details. The infrequent use of this data makes a careful sorting and sifting of these cumbersome details a waste of time.

Location of Values.

For a single factory the location of values resolves into arranging plant figures according to building confines. These facts become important in all fire-insurance matters. With purchased appraisals this viewpoint is popular because it is easy to classify fixed property according to its location in a building. Information of this character will be of service in cost accounting only when departmental and building lines coincide.

Departmental Ownership.

For cost accounting purposes the plant must be classified according to departmental ownership; the division follows the organization of the business. Even in a small enterprise, the accounting scheme cannot immediately approach the individual machine but must resort to intermediate groups. This is done to avoid the risk of becoming lost in a maze of detail—as with other things, we must first get a perspective to be able to block in the minutiae.

Process Use.

Further down on the scale of division we come to individual machines or the small groups of them which constitute the logical focal points for process costs. It is possible to pay some attention to these subdivisions while arranging departmental values, but in general, further calculations are necessary to arrive at the exact depreciation charge for each unit of processing. Numerous fixed-property items, such as shafting, piping, etc. are related to more than one process; consequently, their values must be apportioned among the various factory operations.

Tying the Classifications Together.

Satisfactory relations between the classifications can be established on two sets of records controlled by the general ledger accounts. On the one hand, we need the original construction records, or a subsequent appraisal. This record completely explains the expenditures which created the controlling book values. On the other hand, we need also a condensed record arranged according to machines, processes, and departments. This account is concerned only with the total value of each unit and serves to explain departmental values. The cost of each unit must be identical in the two books. To get a better idea of the subject it now will be desirable to look into the various items found in each of the controlling accounts.

Land.

Under the caption *Land* is placed the original acreage cost and all subsequent improvements thereto. Such things as pavements, wells, railroad sidings, etc. are logically included here because at a time of liquidation they cannot be separated from the land. Idle land should be kept apart from occupied land in the books of account, as should items which must be depreciated.

Buildings, Structures, etc.

The buildings and structures erected on a property are highly individual things which present no accounting problem. They are usually serially numbered and referred to by number in all the records.

Plant.

The design of a serviceable plant classification usually proceeds smoothly up to a certain point and then it is overwhelmed by a horde of perplexing problems. To make any headway with the situation, it is necessary to first rule out the nondescript. There are many factory items which have no market value, even though they are essential to the conduct of operations. Such things can profitably be dropped out of the accounting picture, or set aside as miscellaneous effects.

The remaining plant items are divisible into two parts whose distinctions are found in their applications to processes. Before this thought is amplified it is necessary to say that, in this issue, the activities of service departments must be considered as processes. To continue, a plant unit either directly performs a process or it performs a service for other units. Scientific custom demands that names be devised for the two classes whose territorial limits have just been circumscribed. Accountants waste two perfectly good words, machinery and equipment, by compounding them together with plant into a rather loose nomenclature. We will, therefore, borrow these terms and apply them to our immediate purpose. Machinery will be used to refer to the mechanical units, whose function it is to perform processes or logical parts of them. Equipment will be used to designate mechanical units or accessories

whose function it is to assist a machine or group of machines to perform processes.

Machinery.

The machinery division can be made more serviceable by following the natural lines of a particular cost system instead of adhering to the classification with scientific exactness. For instance, it is wise to consider as equipment all portable devices which, by virtue of the definition, might fall into the machinery account. Further, it is often desirable to consider some equipment as part of a machine. At times, cost accounting is improved by throwing some of the immediate accessories which are normally part of a machine into the equipment account. Just how far the province of an individual machine can be extended is not always apparent. Experience in a specific line brings the answer for the conditions existing in that industry.

An analysis of machinery requires a preliminary survey of processes. The factory operations give names to the units and purpose to the classification. Very little effective work can be done until the manufactures are understood, and the basic plan for the cost system has been developed. Although impressive accounts can be devised without this knowledge, the results from a cost-accounting viewpoint will be distinctly disappointing.

Equipment.

Even though equipment does exist in endless variety, relatively few principles underly its control. A correct approach to equipment classifications compels us to consider at the outset whether the accessory has itinerant characteristics or is of such staid habits as to be always found in the same place. The size of the investment in a particular species of equipment determines the creation of a separate accounting classification for it. Several of the more important classes of equipment will be discussed to more fully illustrate the subject.

Mechanical-power-transmission Equipment.

Power-transmission equipment is interesting for the purposes of discussion as it brings us face to face with both itinerant and stationary equipment, and also raises as an issue the desirability of including parts of it with individual machines. Under this caption we have four subdivisions namely:

1. Shafting, hangers, and accessories.
2. Speed-changing devices, gears, etc.
3. Pulleys.
4. Belting.

Shafting, hangers, etc., usually serve many machines and should be put in the stationary equipment class. Countershafts are properly grouped with line shafts, because to charge them to a machine would, in effect, penalize that unit for its less favorable factory location. Local countershafts are frequently speed reducers and, with other devices of the same sort, in general, are included more logically with individual machines. The subject is not above controversy as there are cases where an adverse judgment is desirable. Even though pulleys may be frequently moved, they should be grouped with shafting to eliminate accounting expense, which will more than offset any benefits to be derived from a distinctive classification.

Real information on belting only becomes available when belts are treated as itinerant equipment with a separate accounting control. Any accessory costing as much and having as short a life as belting requires close supervision. By giving all belts identifying numbers, the life story of each one can be recorded. The knowledge gained leads to a readjustment of drives and a selection of proper types of belting. In this way we can achieve operating economies in excess of accounting expenses.

Electrical Equipment.

An analysis of electrical equipment reveals conditions quite similar to those found for power-transmission equipment. Wiring, panels, instruments, etc. can be treated like shafting. Motors and starting devices present an itinerant problem like belting. With the last two it is worth while to have an historical record giving the place and period of service, repairs made, etc., so that we came to sound engineering conclusions on operating performance.

Pumps, Piping, etc.

When a considerable number of pumps are used an accounting method similar to the one for belting is convenient. Piping, on the other hand, presents a unique problem. It will not do at all to lump piping into one account for its functions are too diverse. We, therefore, come to subheadings such as:

a. Steam.
b. Heating.
c. Air.
d. Vacuum.
e. Water.
f. Refrigeration.
g. Gas.
h. Underground.
i. Manufacturing.

To divide steam supply lines up into mains, branches, accessories, etc. seems like a meritorious proposal, but it generally proves to be unmanageable. It is difficult to set rules for the separation, and a specific section of pipe is not easily identified in a maintenance work order. If the values are all lumped together and process steam costs are calculated, "*delivered at the consuming machine,*" then none of the units are penalized for their remoteness from the power house or for errors in the repair charges. Similar methods can be adopted for the other kinds of piping.

Process piping should be subdivided so that the value pertaining to each manufacture is known. It is difficult to go further and assign piping to specific machines. In some industries, process-piping values run as high as 200 per cent of the machinery costs. In such cases periodic inventories of existing lines should be made. The basic principles of piping analysis are to follow natural lines of cleavage and not to attempt too ambitious a program.

Tools, Instruments, etc.

A lot has been written about tool room management. It is not the intention here to trespass in that direction; but rather to point out that the quantity of tools used prescribes the method. The total cost rather than the number involved suggests the accounting procedure. With tools, instruments, scales, trucks, etc., the life-history method employed for belting is most useful. Periodic inventories are needed to attest the accuracy of the accounts.

Miscellaneous Effects.

In addition to the captions which have been discussed, Miscellaneous Effects will often be found a useful accounting vehicle to carry the values of furniture and the other thousand and one accessories which it is not desirable to put in either the machinery or equipment category. To ignore many of them altogether is a meritorious proposal. If there is some hesitation about omitting them they should be depreciated at a very rapid rate.

Patents, Formulae, Design, etc.

If patents, formulae, design, etc. are included among the assets, documentary evidence of these intangibles should be preserved in the files. To reduce formulae to writing is an exceedingly difficult task, yet it is a commendable effort because it directs many searching inquiries into existing methods and thereby is often instrumental in developing vastly improved processes.

Fixed-property Codes.

Many codes have been suggested for identifying supplies, materials, equipment, machinery, etc. Few, if any, ever break through their own intricacy sufficiently to be of great value to anybody beyond the few specialists who are in daily contact with them. For this reason, fixed property should be marked in a simple way. Using the machine names supplemented by a serial number to differentiate those of like kind is a good scheme. Nothing particularly complicated should be devised as it confuses the factory workers, and the code is not used enough to result in the economies achieved by a mnemonic classification of parts for machinery manufacture.

CHAPTER XVIII

FIXED-PROPERTY ACCOUNTING

The Purpose of Fixed-property Accounting.

Exact knowledge of fixed-property details makes it possible for us to arrive at the real decrease in values of machinery and related facilites, resulting from use, time, fashion, invention, etc. As a means of establishing asset valuations, this accounting is only incidental for the values are many hued, depending quite humanly on whether items are being listed in a buyers' market, a sellers' market, an insurance appraisal, a replacement estimate or a stockholders' report. From a cost-accounting viewpoint, the primary purpose of fixed-property accounting must ever be the determination of correct depreciation charges.

The Depreciation Problem.

Unquestionably, depreciation is the most difficult, complicated, and controversial topic in the realm of factory accounting. The reason for the complexity of the problem can best be brought out by considering the depreciation calculations for a one-story manufacturing building with brick walls, mill construction, and a slag roof. Let us assume that originally the building cost $5,000. It was granted a life of forty years and has been depreciated at the rate of 4 per cent of the first cost per annum, believing this amount to be sufficient to cover all renewals made during its expected life.

Today we find it desirable to erect a new building and naturally we want to find out how much of the first cost has been retrieved through the sale of goods. A comparison between estimated and actual conditions is set up in Table XXXVI. A mere matter of rising renewal costs over a long period of years has resulted in a 60 per cent loss on the transaction. In addition to this, we are faced with the fact that a new building costs about three times as much as the old. Evidently there are many angles to the depreciation problem. Before going further with the topic, from the factory viewpoint, it is well to consider the subject of depreciation methods and rates.

TABLE XXXVI.—COMPARISON OF ESTIMATED AND ACTUAL DEPRECIATION

Renewal costs and the rate on a one-story brick building, mill construction, slag roof.

Renewals	Estimate in terms of first cost	Actual costs
Slag roof, 3 renewals	$ 450	$ 950
Timbers, etc	1,850	3,600
Miscellaneous	700	1,450
Total renewals	3,000	6,000
First cost of building	5,000	5,000
Depreciation required	8,000	11,000
Depreciation per year for 40 years	200	275
Depreciation rate	4 per cent	5½ per cent

Depreciation Methods.

Kester, in his book, "Theory and Practice of Accounting," volume II, published by The Ronald Press Company, has discussed the known methods at considerable length. Of the many given, possibly only two are really popular in the manufacturing industries. One uses a fixed percentage of the first cost and the other a fixed percentage of the depreciated cost. The first is better adapted to cost work because the second, although it does more nearly give the intermediate asset value, punishes the earlier production at the expense of subsequent manufactures. Intelligent cost finding requires uniform depreciation rates.

No method can be analysed correctly except it is considered in conjunction with renewals. A ruling of the Internal Revenue Department directs that renewals be set up as a charge against depreciation, or in other words, we are asked to increase the asset valuation by reducing the reserve. When this procedure is followed and straight-line depreciation is used, we obtain more uniform increments of cost than by any other treatment of the problem. This acceptable result, superimposed upon the simplicity of taking a fixed percentage of first cost, forms a weighty argument in favor of straight-line depreciation with renewals as an offset to the reserve. Before leaving the subject it is well to again call attention to the hazard of using unduly low rates, previously pointed out by Table XXXVI.

Depreciation Rates.

Depreciation rates cannot be applied with the same certainty as to outcome that is attained in life insurance. An insurance company does business with a large number of individuals and thereby receives the protection of averages, but a manufacturing company uses few machines from a group, for which a life expectancy has been worked out. The probability of having on hand one of the worst components of an average is great. For this reason it is always well to be a pessimist on depreciation rates.

Referring again to Table XXXVI, we see that much of depreciation, even when applied to a specific asset, is a question of establishing serviceable average rates. With a building we have one expectancy for brick work, another for lumber, another for roofing and numerous different life terms for the miscellaneous accessories. To expect to be able to predict an accurate rate for this heterogeneous mixture over a long term of years in the face of increasing and decreasing renewal costs is the triumph of hope over experience. While seeking to avoid the sloughs of meticulous detail we ride the fences of average for a fall. We may well ask where is the safe road.

Those who solve the depreciation problem by setting up a percentage of the total value in the controlling accounts are not altogether unwise. This method, however, denies them all detailed knowledge of their fixed property and they never arrive at the cost of individual machine performance. We must know separate fixed-property items for accurate cost finding, for good operating performance, for correct asset valuations, and for proper insurance coverage. When we are in possession of this information, secured either from original records or by appraisal, we can use appropriate rates for each unit and arrive at a total depreciation charge more in harmony with actual conditions.

Depreciation rates for specific assets are given at great length in the "Accountants' Handbook" published by The Ronald Press Company. This important contribution to the literature on depreciation gives in all cases the source or authority for the rate. The entire section (No. 11 in the 1923 edition) on depreciation can be consulted profitably by anyone interested in the subject. A carefully thought out list of rates is to be found in F. W. Kilduff's "Auditing and Accounting Handbook," published by the McGraw-Hill Book Company, Inc., New York.

The Factory Obsolescence and Depreciation Problem.

In a general discussion we have touched on some of the many aspects of depreciation. As the problem is narrowed down to the factory viewpoint, annoying complications increase rather than diminish. A manufacturer must consider not only the expected life of his fixed property, but also must recognize the probability of changing fashions or simplified production methods ending the profitable use of his facilities. This element of depreciation is commonly called obsolescence.

The unfortunate feature of obsolescence is that no one can tell at what moment it will descend upon him with startling unexpectedness. Modern industrial life is replete with examples. We have the radio *versus* the talking machine, the automobile *versus* the horse, trolley car, train, etc., electric refrigeration and dry ice *versus* ice, etc. As we reflect on the subject of obsolescence we come to realize that it may cause slow strangulation of an industry or may make an almost immediate end of further profitable production. The organic chemical field is open to more drastic obsolescence influences than any other manufacture. An improved process may quickly depress selling prices below the raw-material costs of the old method. Research is always directed toward finding ways of effecting, with cheaper raw materials, chemical combinations which are known to be theoretically possible. The attitude of an industry living in such an atmosphere of obsolescence is of interest. The European chemists believe in completely amortizing the cost of a plant at an early date.

Depreciation becomes of utmost importance when selling prices have fallen to that low point where the operating results can be changed from a profit into a loss by a moderate change in the rates. While a company is making plenty of money the tendency is to be extremely liberal with these allowances, but when costs must be pared this is the first place to be attacked. Usually the squeezing goes on until the charges are no longer adequate. A business returning substantial profits is in a position to grow, but when the gains depend on closely figured depreciation, a dormant period has arrived which is but the forerunner of ultimate death.

As we review the factory-depreciation problem, it becomes patent that first we must have a detailed inventory of the fixed-property investment. With this as a starting point we can set individual rates, designing each one to reflect the minimum life of the asset, the factor of contingent obsolescence, and the probable appreciated cost of renewals during its expectancy. We cannot use the more precise calculations of public utilities because we do not work under their relatively staple conditions. The extreme hazards of manufacturing dictate the utmost dispatch in retrieving fixed investments. After the asset values (first cost plus renewals) have been extinguished, it is proper to

lower the depreciation rate to approximately offset the continued expense of renewals. It is not, however, within the province of pure depreciation to establish a reserve which is equal to the enhanced value of a new machine at the conclusion of the cycle.

The Depreciation Ledger.

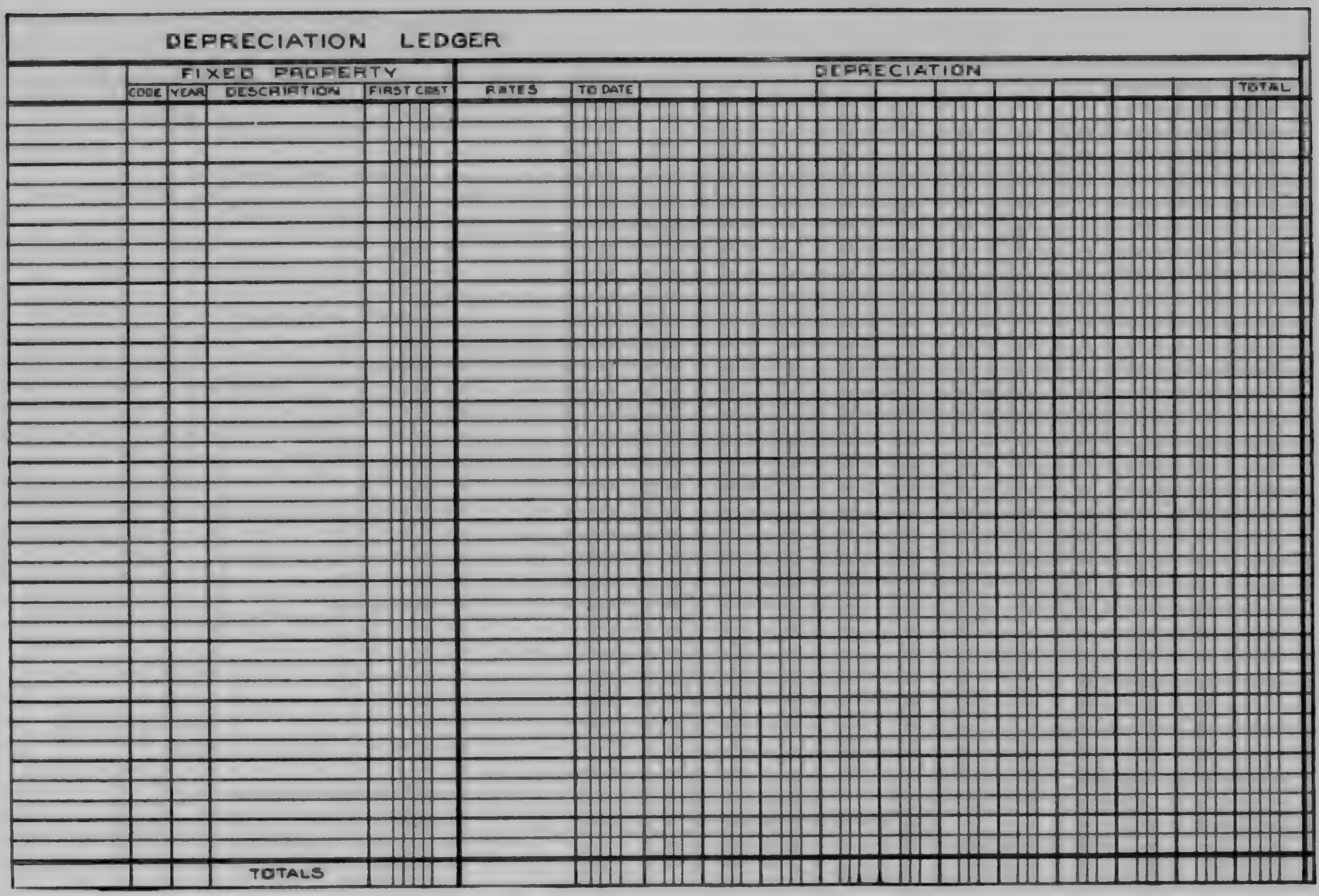
The purpose of this section is to explain a simple method of recording depreciation charges. Figure 39 shows a ledger sheet designed to serve 10 years. Columns have been provided for identifying code letters or numbers, the date of installation, the name of the unit, the first cost, the rate used, the depreciation taken to date, the charges for 10 years, and a horizontal total to be posted to a new sheet. The most satisfactory arrangement is had by grouping machinery according to departments (see Chap. XVII). The depreciation ledger sheets must be footed up to get the annual charge for the general ledger. The postings are made most conveniently at the end of the year—the debit entry is set up in the account Depreciation Accrued. Current monthly charges for the cost calculations can be deduced from the values of the preceding term. Figure 40 illustrates the use of the depreciation ledger.

Fixed-property Ledger.

The depreciation ledger sheets give a satisfactory summary of fixed-property items. The values must agree with the corresponding new construction sheets or with some other original source such as an appraisal. It is needless to say that all of these records must be reconciled with the controlling accounts in the general ledger before they can be accepted as components of a cost system.

New Construction.

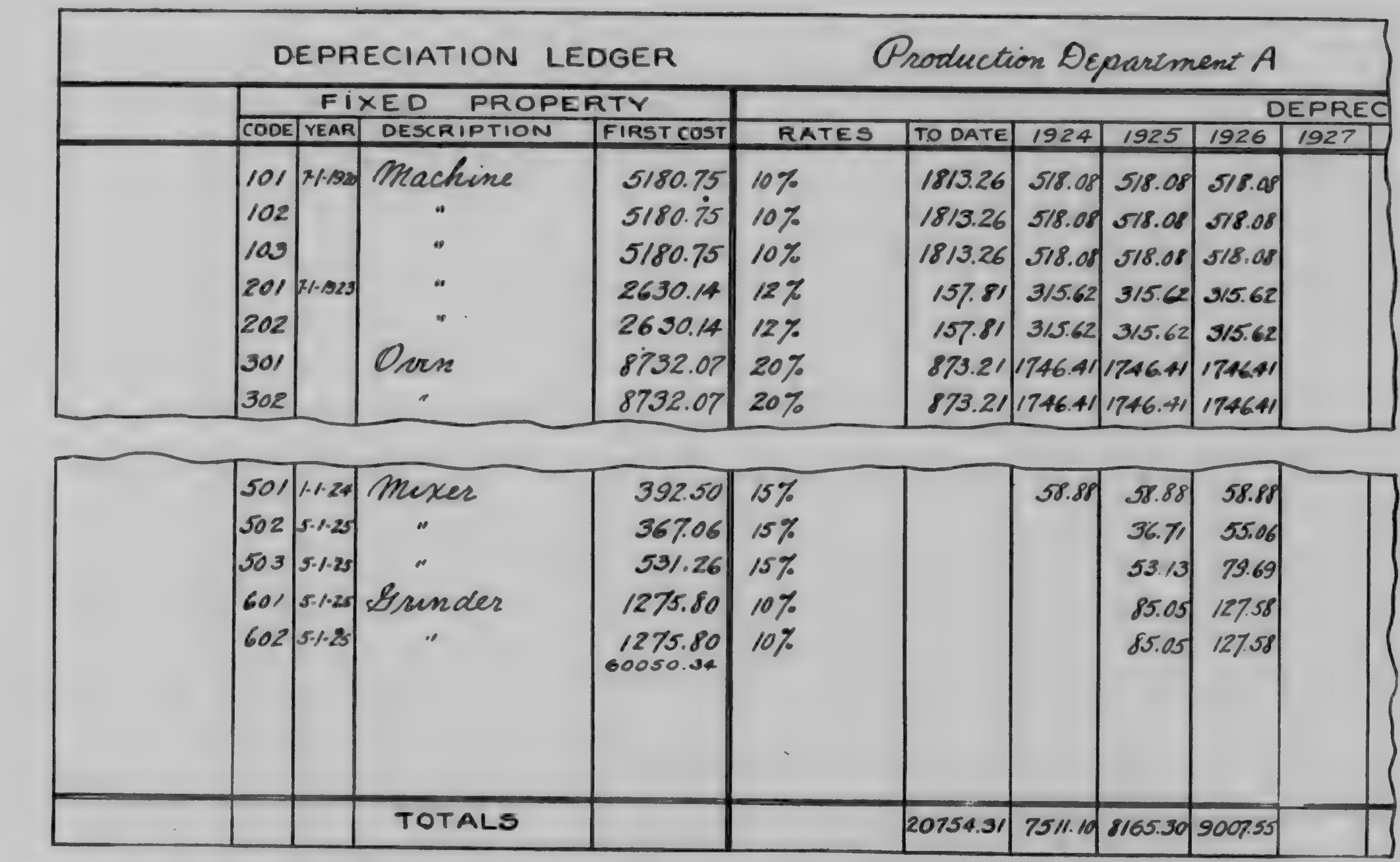
Figure 41 shows a sheet which is useful in recording all forms of factory construction work. The four columns make it easier to check the entries with the controlling



DEPRECIATION LEDGER

FIXED PROPERTY				DEPRECIATION		
CODE	YEAR	DESCRIPTION	FIRST COST	RATES	TO DATE	TOTAL
		TOTALS				

FIG. 39.—Depreciation ledger.

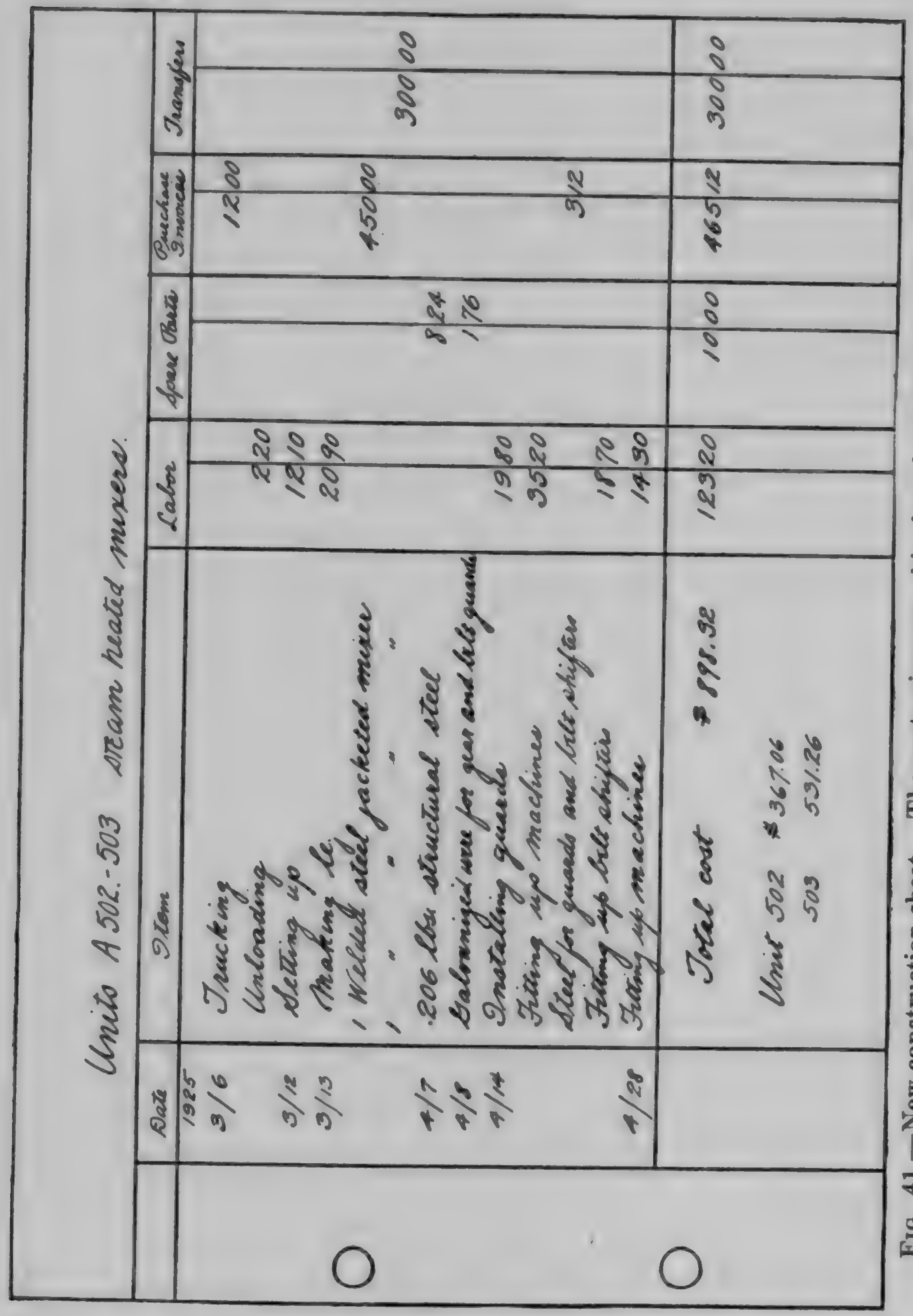


DEPRECIATION LEDGER Production Department A

	FIXED PROPERTY				DEPREC					
	CODE	YEAR	DESCRIPTION	FIRST COST	RATES	TO DATE	1924	1925	1926	1927
	101	7-1-1920	Machine	5180.75	10%	1813.26	518.08	518.08	518.08	
	102		"	5180.75	10%	1813.26	518.08	518.08	518.08	
	103		"	5180.75	10%	1813.26	518.08	518.08	518.08	
	201	7-1-1923	"	2630.14	12%	157.81	315.62	315.62	315.62	
	202		"	2630.14	12%	157.81	315.62	315.62	315.62	
	301		Oven	8732.07	20%	873.21	1746.41	1746.41	1746.41	
	302		"	8732.07	20%	873.21	1746.41	1746.41	1746.41	
	501	1-1-24	Mixer	392.50	15%		58.88	58.88	58.88	
	502	5-1-25	"	367.06	15%			36.71	55.06	
	503	5-1-25	"	531.26	15%			53.13	79.69	
	601	5-1-25	Grinder	1275.80	10%			85.05	127.58	
	602	5-1-25	"	1275.80 60050.34	10%			85.05	127.58	
			TOTALS			20754.31	7511.10	8165.30	9007.55	

FIG. 40.—Depreciation ledger details. A portion of Fig. 39 is shown here to illustrate its use as a depreciation ledger. The detailed construction costs of items 502 and 503 are given on Fig. 41.

accounts in the general ledger. Construction work usually involves a vast amount of detail which must be reconciled monthly if one does not wish to run the risk of having many hours wasted in looking for small errors. One column is used for labor items, another for factory accounts, such as supplies, spare parts, etc., another for purchase invoices, and another for machinery transfers from idle equipment, etc. If there are many pages the monthly values should be entered on a master sheet to expedite a comparison with the controlling accounts.



Units A 502-503 Steam heated mixers.

Date	Item	Labor	Spare Parts	Purchase Invoices	Transfers
1925					
3/6	Trucking			12.00	
	Unloading	2.20			
3/12	Setting up	12.10			
3/13	Making &c.	20.90			
	1 Welded steel jacketed mixer			450.00	
	1 " " "				300.00
4/7	206 lbs. structural steel		8.24		
4/8	Galvanized wire for gear and belt guards		1.76		
4/14	Installing guards	19.80			
	Fitting up machines	35.20			
	Steel for guards and belt shifters			3.12	
	Fitting up belt shifters	18.70			
4/28	Fitting up machines	14.30			
	Total cost $898.32	123.20	10.00	465.12	300.00
	Unit 502 $367.06				
	503 531.26				

FIG. 41.—New construction sheet. The costs given on this sheet have been transferred to Fig. 40.

New Construction accounts, like all other fixed-property records, should not be opened without proper authorization. They should also be definitely closed and transferred to the fixed-property accounts as soon as the work is finished. As the sheets are designed to give machine or other unit-cost totals they should be carefully planned in advance of the construction work by some competent authority, such as the engineering department.

The arrangement of facts on new construction sheets, being chronological, will be intensely disordered from a narrative viewpoint. With their vast amount of detail it will hardly be advisable to attempt to recapitulate them; besides, for ordinary business affairs only the totals are of consequence. On the occasion when some particular unit becomes of interest, then the facts can be profitably put into a more orderly array.

Betterments.

Betterment accounting differs from new construction in that the final results must be analysed to eliminate overstated costs. The excess cost is debited to the surplus account in the general ledger as a loss instead of being allowed to assume an asset value in the fixed-property records. We get into these calculations when we rearrange machinery. The original cost includes a charge for placing equipment and the Betterment account shows a charge for the cost of placing it in a new position. Before the betterment can be transferred to the Plant account it is necessary to write off the cost of the original location as a loss. The depreciation reserves are not altered because the life of the machinery has not been increased.

Replacements.

In the literature of accounting, the term *replacement* is used synonomously with renewals, and to some extent, with repairs. It is good practice to assign different meanings to these expressions, and besides, their separate services are needed to define different activities. Replacements is used in the text to state the cost of substituting a new unit for an old one, but it is not held down to the narrow limits of having the two identical, for such events occur rarely in a factory. The technique of replacement accounting differs from new construction only in that an asset value must be extinguished in total on the fixed property records before replacement costs can be entered.

Renewals.

Renewal is used in the text to connote the installation of new parts in an old machine or other facility. As renewals increase the life of a machine they are not charged against production, but are posted to a separate account which is treated as an offset to the depreciation reserves. Renewals are interpreted correctly not by dissipating them through higher product costs but by absorbing them through longer depreciation periods.

A sheet like Fig. 41 will be found useful in recording detailed renewal costs. At the end of each month the charges should be reconciled with the controlling accounts in the general ledger. If the renewals are tabulated annually on a sheet like Fig. 4 or Fig. 39, the values are instantly available for depreciation studies and for calculating the loss on scrapped fixed property.

Repairs and Maintenance.

Repairs, popularly linked with maintenance, does not convey a precise meaning and it is difficult to make the term less obscure. In the text it is used in the sense of upkeep. Repairs serves to record the charges for upkeep when the work is done by contractors. Maintenance does not appear in the text as it has been replaced in the cost calculations by the charges of the mechanical department.

It is hard to draw a fine line between upkeep and renewals. Any attempt to demarcate the two by setting an arbitrary value at which a maintenance item becomes a renewal is not very satisfactory. Such a procedure easily might become a case of chopping off the dog's tail by inches, for, should we design to do renewals in a piecemeal fashion, they would be charged off as maintenance. The answer lies in being lenient as to the interpretation of renewals and liberal as to depreciation rates. This practice insures more uniform costs which, after all, is one of the primary necessities of cost accounting.

Idle Fixed Property.

Idle fixed-property accounting brings no complicated problem. The technique is identical with that established for the production departments on Fig. 6. Immediately below them an idle fixed-property account can be placed. To it are charged depreciation, taxes, and all other costs. The amount posted to the process ledger is written off as a loss in the cost variation account. Corresponding segregations of idle units are made in all of the fixed-property records.

Scrapped Plant.

With the New Construction, Betterments, and Replacements accounts we have thrown up a protective fence preventing unwarranted entry of charges in the fixed property records. It is equally important to fashion similar devices to preclude the possibility of misleading deductions being made from the asset accounts. Scrapped-plant and fire losses are the major sources of fixed-property credits Their accounting technique will be discussed at length.

The easiest way to explain the accounting method is to follow through the routine in an example. Units from an abandoned plant are often sold before it is convenient to write off the loss. All money received in this way should be credited to a salvage account where it can be held until it is convenient to state the final result. Similarly, at the conclusion, some equipment with a market value will remain unsold and this can be transferred to the account Fixed Property for Sale at its probable cash value, less anticipated expenses. In the example the final wrecking was performed by an outside rigger and appears as Liquidation Expense. Sometimes it is more proper to capitalize the wrecking as part of the cost of the subsequent plant. Table XXXVII shows the calculations. The journal entries for the general ledger have been given in Table XXIV.

TABLE XXXVII.—LOSS CALCULATION FOR A SCRAPPED-PLANT UNIT[1]

First cost of unit		$10,987.58
Depreciation reserves, 4½ years at 15 per cent to be deducted		7,416.62
Depreciated value		3,570.96
Renewals to be added		563.08
Present book value		4,134.04
Value to be realized:		
Salvage	$ 350.00	
Fixed property for sale	1,925.00	
Total to be deducted		2,275.00
Value to be scrapped		1,859.04
Liquidation expense		750.00
Loss on scrapped-plant unit		$ 2,609.04

[1] For journal entries, see Table XXIV.

Fire Loss.

Whereas depreciation is only concerned with recovering the first cost plus renewals, fire insurance recognizes appreciated values. We insure in order to be able to put our assets in the exact condition that they were before a fire. The insurance companies contract to pay us the price of new equipment less sufficient depreciation to bring the machine into the same used condition as the one destroyed; but they say that any sum so paid shall not exceed the cash value of the machine at the time of the fire, and they also reserve the right to pay, instead, the cost of repairing the damaged items. These aspects make the adjustment of fire losses on the books of record a little more involved than they are usually held to be.

Possibly the favorite method of entering fire losses is to credit the fixed-property accounts with the money received from the insurance companies and to charge the assets with replacement costs. This is a simple procedure, but a most disastrous one for all underlying detailed records. Those books which have anything to say on the subject suggest we open a fire-loss account, credit it with the insurance money, and charge it with the net book value of all assets destroyed plus all expenses incurred, and then they tell us to post the net result to the surplus account in the general ledger. This method is kinder to the detailed records, but it hardly states the case completely.

Suppose, for the purposes of illustration, a machine costing us $1,000 is completely destroyed by fire. On the books it has been depreciated 50 per cent. The insurance companies verify that a new machine costs $2,000 and that the cash value of the old one was $1,000 at the time of the fire. They pay us the $1,000. Now, according to the prescribed methods of accounting, disregarding other expenses, we have made a profit of $500 and to dodge the issue we credit the gain direct to surplus. Anyone who has been through a fire would hardly care to concede that he is in that amount.

Several alternatives are now open to us. If we are fortunate enough get a second-hand unit of the same general condition installed for $1,000 and we credit the gain to the depreciation reserve, we are, for all practical purposes, in the same position as before the fire. Suppose, on the other hand, we are compelled to go out and get a brand new machine costing $2,000. The insurance company gave us $1,000, but the other $1,000 we must raise out of our own resources. At this time we realize what a sad mistake the name Reserve for Depreciation really is and we feel stimulated to ask accountants to change it. Trying to raise the extra money gives us the sensation of being out $1,000 instead of in $500.

The newly installed machine can be entered on the records in three ways. With the first we follow the prescribed technique; charge $2000 to plant as a first cost, enlarge the surplus by $500 and begin the depreciation reserve at zero. The second differs from the first only in that the $500 is not posted to surplus but is deducted from the first cost so as to charge only $1,500 to plant. The third charges $2000 to plant and sets up the $500 in the depreciation reserve. With two of the methods the depreciation element of unit article costs is doubled over what it was before the fire and with the other this part of the product cost is advanced only 50 per cent. The last method reduces the term over which depreciation must be taken. It is not the intention to extol the virtues of any particular scheme but only to present them all so fancy can take its choice. After the fire replacements have been made, one would hardly be so rash as to say he had gained through the fire.

Having examined the one extreme where the property is a total loss, let us look at the other where only a reconditioning is involved. The settlement of the insurance claim usually precedes the actual work of repairing. It is indeed a fortuitous chance if one has exactly predetermined the cost of putting fire-damaged equipment into a serviceable state. Money received in fire adjustments for repairs involves a gamble, for we may gain or lose by the transaction.

As fire claims generally deal with partially and completely destroyed property, the accounting technique must be adapted to this circumstance. The claim allowed is credited to the Fire Loss account and debited to the Accounts Receivable. The unexpired premiums on cancelled insurance, the cost of all repairs, the depreciated book value of completely destroyed property and the value of damaged stock are debited to the Fire Loss account and credited to the accounts in which these values were carried prior to the fire. All engineering and office expense incident to the mishap, together with all adjuster's fees should also be charged in as a loss. The balance finally left in the Fire Loss account can be disposed of according to any one of the methods previously discussed. At one time the Internal Revenue Department felt inclined to regard a surplus residual of this kind as a profit, but it is hardly that, for if the entire cost of the disruption to the enterprise was included, few indeed would be the cases where a fire showed a profit.

The costs of erecting new units to replace those destroyed by the fire are entered on the fixed property records in the same way as new construction work, because the old values have been removed from the books through the Fire Loss account. Much information on insurance is to be found in "Specialized Accounting," by Newlove and Pratt, published by the McGraw-Hill Book Company, Inc.

Conclusion.

Fixed-property accounting drives home a valuable lesson with more vigor than any other phase of accounting. Diversification of products is often looked upon as a means of stabilizing business profits. This is partially true, but there are limits beyond which diversification cannot be carried without creating an unduly high accounting expense. A substantial volume of production must exist to reduce accounting costs to sane levels. Adequate bookkeeping cannot be abandoned, for it, more than any other art, can be used to set the boundaries of economical production. In factories many a small unit is carried whose real overhead wipes out the market revenue. Such equipment need not be abandoned, but can be leased, as is often done in other industries.

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